

COPY No. 55

BR. 257  
HANDBOOK  
FOR THE  
4 INCH Q.F. MARK XVI\* GUN  
ON THE  
H.A. TWIN MARK XIX AND SINGLE  
MARK XX MOUNTINGS

1941

**RESTRICTED**

**B.R. 257**

**HANDBOOK**

**FOR THE**

**4 INCH Q.F. MARK XVI\* GUN**

**ON THE**

**H.A. TWIN MARK XIX AND SINGLE  
MARK XX MOUNTINGS**

PZ 1572/5

**1941**

NAVAL ORDNANCE DEPARTMENT,  
ADMIRALTY,  
*July, 1941.*

G. 3821/41.



ADMIRALTY, S.W.

27th August, 1941.

G.3821/41.

B.R. 257 Handbook for the 4-in. Q.F. Mark XVI\* Gun on the H.A. Twin Mark XIX and single Mark XX mountings, 1941, having been approved by My Lords Commissioners of the Admiralty, is hereby promulgated for information and guidance.

This edition supersedes O.U. 6361/1937, copies of which should be disposed of in accordance with the instructions in Form O.U. 2A—Catalogue of O.U. Books.

*By Command of Their Lordships.*

*H. V. Markham*

To Flag Officers and Commanding Officers of  
H.M. Ships and Vessels concerned.

Amendment No. w change	Authority.	Date of insertion in this copy.	Initials.
1.	P. 208.	7. 7. 43.	E. Woodman.
2.	P. 221.	13. 7. 43.	—
3.	P. 575.	13. 11. 43	E. Woodman
4.	P. 254.	13. 11. 43	E. Woodman
5.	P. 262.	12. 5. 44.	E. Woodman
6.	P. 410.	19. VII. 44.	E. Woodman.
7.	P. 418	33. 8. 44	St. Barbell
8.	P. 579	4. 10. 44	H. Hoare.
9.	P. 715.	2. 11. 44	H. Hoare.
10.	P. 800	12. 12. 44	Dr. Wilkins
11.	P. 186/45	14. 4. 45	Dr. Wilkins
12.	P. 8/46	5. 2. 46	Dr. Wilkins
13. <del>13</del>	P. 355/47	14. 11. 47	Dr. Wilkins
14. <del>14</del>	P. 388/47	2. 2. 48	Dr. Wilkins
15	P. 278/48	17-10-48	JS
16	P. 505/48	17-12-48	JS
17	P. 559/48	8-1-49	JS
18.	P. 374/49	19-10-49	H.F.W.
19.	P. 21/50	6-2-50	H.F.W.
20.	P. 71/50	8-3-50	H.F.W.
21.	P. 253/50	24-6-50	H.F.W.
22.	P. 9/51	20-1-51	H.F.W.
23.	P. 526/51	5. 1. 52	ML
24.	P. 110/52	17. 6. 53	Dr. Wilkins
25.	P. 274.	10. 7. 53	Dr. Wilkins
26.	P. 46/55	7. 12. 55	Dr. Wilkins
27.	P. 108/58	2. 4. 58	Dr. Wilkins
28.	P. 225/59	13-5-59	Dr. Wilkins
29.	P. 381/60	31. 8. 66	Dr. Wilkins
30.	P. 329/66.		Dr. Wilkins



## CONTENTS

Index to plates .. .. . Page 6

Frontispiece: The 4-in. Twin Mark XIX Mounting .. .. . Facing page 7

Section.	CHAPTER I	Page.	Relevant Plates.
1. Introduction .. .. .		7	—
Particulars of guns and mountings .. .. .		8	1, 2, 3, 4, 5
2. Lubrication .. .. .		11	39, 40

## CHAPTER II

1. The Gun .. .. .	12	6
2. The Breech Mechanism .. .. .	12	7, 8, 9
Firing Mechanism .. .. .	15	10, 11
Action in S.A. and Q.F. .. .. .	18	—
3. The Semi-Automatic Gear .. .. .	21	12, 13
Adjustment of the S.A. Gear .. .. .	22	14
4. The Hand-Operated Percussion Firing Gear .. .. .	23	15

## CHAPTER III

1. The Training Base, Centre Pivot and Rollers .. .. .	24	16
2. The Cradle, Recoil and Run-out Arrangements .. .. .	25	17, 18
3. The Trunnions .. .. .	29	19
4. The Hauling Back Gear .. .. .	29	20

## CHAPTER IV

1. Elevating Gear .. .. .	30	21
Arrangement of Worm Drive and Pinion .. .. .	30	22
Gunlayer's Firing Gear .. .. .	31	23
2. Safety Firing Gear .. .. .	31	24
Interceptors, MKS, 446 .. .. .	32, 32 D	25, 25 A
3. Elevation Receiver—Mechanical Pointer Drive .. .. .	32	26, 24 A
SAFETY FIRING GEAR FOR ROCKET FLARE LAUNCHERS .. .. .	32 C	24 B

## CHAPTER V

1. Training Gear .. .. .	33	27
Training Worm Gear Drive, Mark XIX Mounting .. .. .	33	28
Training Worm Gear Drive, Mark XX Mounting .. .. .	34	29
2. Training Buffer, Training Limit stops and Housing Locking Bolt .. .. .	34	30
3. Training Receiver—Mechanical Pointer Drive .. .. .	35	31

## CHAPTER VI

1. The Sighting Arrangements .. .. .	36	32, 33, 34, 35, 40
2. Method of Sight Testing .. .. .	38	Diagrams A, B, C
3. Electrical Circuits .. .. .	44	36, 36 A, 36 B, 36 C, 36 D, 36 E, 36 F, 36 G, 36 H, 36 I, 36 J, 36 K, 36 L, 36 M, 36 N, 36 O, 36 P, 36 Q, 36 R, 36 S, 36 T, 36 U, 36 V, 36 W, 36 X, 36 Y, 36 Z
4. Dismounting Gear for changing Loose Barrels .. .. .	44	37
5. Lifting Gear .. .. .	47	38

## APPENDIX I

Key to Lubrication Diagram .. .. .	48
------------------------------------	----

## APPENDIX II

Schedule of Component Parts of Breech Mechanism .. .. .	50
---	----

## APPENDIX III

List of Spare Parts .. .. .	52
-----------------------------	----

## APPENDIX IV

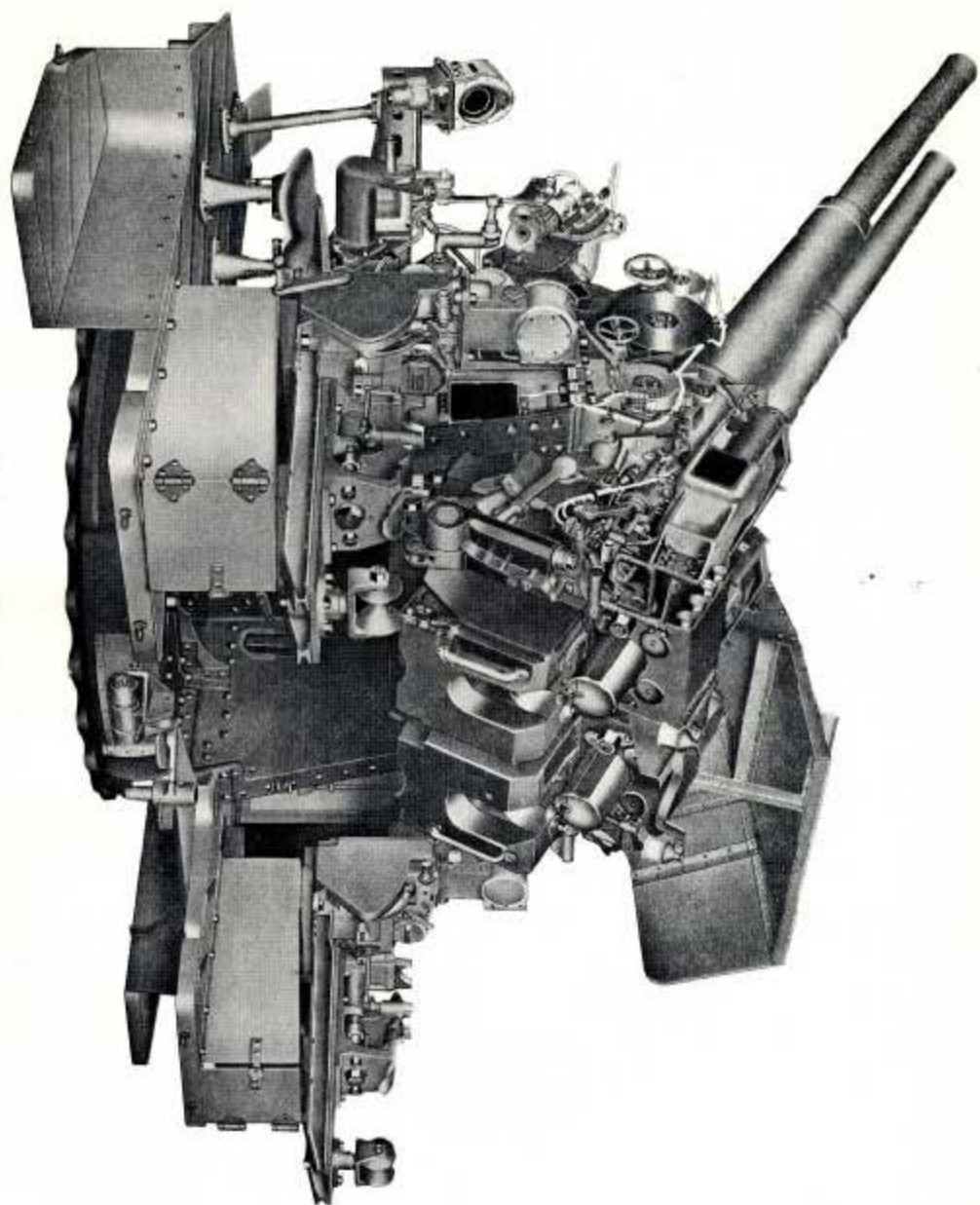
Details and numbers of modifications to Mounting .. .. .	Page 56
After page 55. Insert the accompanying Appendix IV (pages 56 to 64).	



## INDEX TO PLATES

Arrangement of Mounting—Mark XIX	.. .. .	1, 2, 3
" " Mark XX	.. .. .	4, 5
Barrel dismounting gear	.. .. .	37
Breech Mechanism—Diagrammatic	.. .. .	8
" " Firing Mechanism	.. .. .	10, 11
" " General Arrangement	.. .. .	9
" " Open and Closed	.. .. .	7
Centre Pivot	.. .. .	16
Circuits—Diagrammatic Arrangement	.. .. .	36
Cradle	.. .. .	17
Dismounting Gear for changing Loose Barrels	.. .. .	37
Electrical Circuits	.. .. .	36
Elevating Gear	.. .. .	21
" " —Arrangement of Worm Drive and Pinion	.. .. .	22
Elevation Receiver—Mechanical Pointer Drive	.. .. .	26
Firing Gear—Hand Operated Percussion	.. .. .	15
Firing Mechanism	.. .. .	10, 11
Gun, 4-in. Mark XVI*	.. .. .	6
Gunlayer's Firing Gear	.. .. .	23
Hand Operated Percussion Firing Gear	.. .. .	15
Hauling Back Gear	.. .. .	20
Housing Locking Bolt	.. .. .	30
Interceptor	.. .. .	25A
Lifting Gear	.. .. .	38
Loose Barrels—Dismounting Gear	.. .. .	37
Lubrication Diagram	.. .. .	39, 40
Mounting—General Arrangement, Mark XIX	.. .. .	1, 2, 3
" General Arrangement, Mark XX	.. .. .	4, 5
Percussion Firing Gear—Hand Operated	.. .. .	15
Recoil Arrangements	.. .. .	17
" Cylinder	.. .. .	18
Rollers	.. .. .	16
Run-out Arrangements	.. .. .	17
Safety Firing Gear—Mark XIX Mounting	.. .. .	24
" " Switch Gear—XIX	.. .. .	24A
Under " Safety Firing Switch Gear	Plate 24A "	(inserted by A.F.O. P.71/50) add :-
" Safety Firing Gear—Rocket Flare Launcher	.. .. .	24B
Firing Circuits—Rocket Flare Launcher	.. .. .	36B "
		(G. 01894/49—A.F.O. P.255/50.)
" " Section through Cross Connections	.. .. .	35
" " Sight Gear Box	.. .. .	34
Slip Gear	.. .. .	20
Training Base	.. .. .	16
Training Buffer	.. .. .	30
" " —Gear	.. .. .	27
" " —Limit Stop	.. .. .	30, 30A
Training Receiver—Mechanical Pointer Drive	.. .. .	31
Training Worm Gear Drive—Mark XIX Mounting	.. .. .	28
" " Mark XX Mounting	.. .. .	29
Trunnion Bearing	.. .. .	19
" modified wrgt. of		19A





THE 4-IN. TWIN MARK XIX MOUNTING.

## CHAPTER I

## SECTION 1—INTRODUCTION

**THE GUN**

The guns are of the quick-firing type, with breech blocks which move downward to open. This arrangement allows the guns to be placed closer together in the cradle, but a large and strong spring is required to close the breech in semi-automatic firing.

**THE MOUNTING**

2. The mounting follows generally the usual design of high angle centre pivot mountings. The guns are mounted in a common cradle and, therefore, elevate together, but each gun is provided with its own recoil and run-out arrangements. To reduce the trunnion height to a minimum, the trunnions are situated close to the breeches of the guns which necessitates the addition of heavy balance weights. The latter are keyed to the guns in front of the breech rings and are provided with pockets which can be filled with lead in order to obtain accurate balancing of the guns about the trunnions.

Mountings forming the H.A. armament of a ship are placed on a 6-in. packing ring. Those forming the primary armament of a small ship where they may be used for either L.A. or H.A. firing are carried on a  $\frac{1}{2}$ -in. packing ring to facilitate loading at low angles of elevation.

**ELEVATING AND TRAINING**

3. Elevating and training positions are fitted on the left and right-hand sides of the mounting respectively.

**SAFETY FIRING GEAR**

4. Safety firing gear consists of a series of levers operated by means of a cam rail secured to the deck and ensures that the firing circuit is broken when the mounting is trained into a danger zone.

*LATER R.P. Series mountings and some plain mountings are fitted with (Safety firing switch gear) (in form of safety firing gear) which breaks the firing circuit independently of the interlock.*

**THE SHIELD**

5. The shield is made of protective plating  $\frac{1}{4}$ -in. thick and is made in halves, bolted together at the front beneath the chase of the guns and connected at the top rear edge by a girder.

P.71/50

**THE SIGHTS**

6. The sights are designed for use in L.A. firing only and no sighting arrangements for controlled H.A. fire are provided. Forward area barrage sights are fitted at layers' and trainers' positions and can be used for local barrage fire up to 70 deg. elevation.

**FUZE SETTING ARRANGEMENTS**

7. Mechanical fuze setting machines or fuze receivers are carried on brackets at the rear edge of the gunlayers' and trainers' platforms.

In RN Ships only, fuze setting machines of the Mark F series have been removed but the fuze setting trays are retained. These have been modified to provide a "rest" position for the ammunition. The setting of starshell fuzes is by means of a hand fuze setting key, No 2, which is kept in a watertight box secured to a base plate fitted on each tray. The guns are illuminated is provided adjacent to the box.

- |  |   |
|--|---|
| (a) Control position .. .. .                       | } For all mountings.  |
| (b) Locally by means of gun layers trigger .. .. . |   |
| (c) Joystick firing switch .. .. .                 | For R.P.51 and R.P.52 mountings only.   |
| (d) Breech workers firing push .. .. .             | For both plain and R.P. series mountings fitted with safety firing switch gear. |

In the event of a missfire or failure of the electric circuit, the guns can be fired in percussion by means of palm operated firing levers.

elevating and training gear vary, but in general the description of the *(G. 07778/48.—A.F.O. P.71/50.)* applicable to the single Mark XX.

**Reports**

10. Identification of a part of the gun or mounting will be facilitated if, in correspondence, the names used in this handbook are employed.

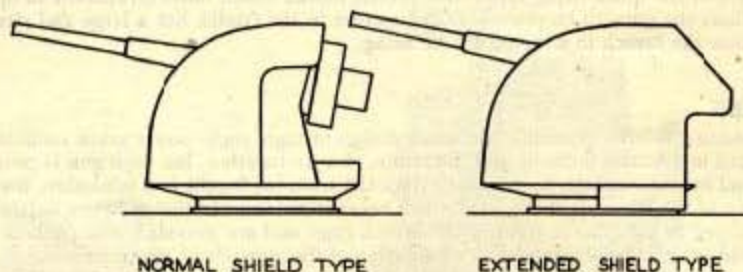


**PARTICULARS OF GUNS AND MOUNTINGS. (Plates 1, 2, 3, 4, 5.)**

**Types**

11. 4 in. H.A. Twin Mark XIX mountings are of THREE types, viz. :—

- (i) The normal.
- (ii) Those fitted with extended shields for use in conjunction with structural blast screens.
- (iii) Those fitted with hand fuze setting positions and no fuze setting machines.



12. The different types are designated by the addition of " \* " for type (ii) and " † " for type (iii) vide A.F.O. 625/38.

Types (i) and (ii) may mount Mark I, Mark II or Mark V fuze setting machines. The Mark V machine is fitted 12 in. forward of the Marks I and II machines on account of the increased length of the shell tray.

Unless otherwise stated, the following details are applicable generally to both the Mark XIX and Mark XX mountings.

**13. Weights**

	Mark XIX	Mark XIX*	Mark XIX†	Mark XX
	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>
(a) (i) Cradle and fittings .. .. .	2.05	2.05	2.05	1.05
(ii) Sight .. .. .	.20	.20	.20	.25
(iii) Carriage, shield and platforms .. .. .	5.20	6.10	5.20	4.40
(iv) Training base complete with rollers and rack .. .. .	1.30	1.30	1.30	1.30
(v) Marks I or II fuze setting machines (total per mounting) .. .. .	.30	.30	—	.15
(vi) Mark V fuze setting machines (total per mounting) .. .. .	.60	.60	—	—
(vii) Hand fuze setting turntables, etc. .. .. .	—	—	.15	—
(viii) Guns (total per mounting including breech mechanisms) .. .. .	4.00	4.00	4.00	2.00
(ix) Balance rings (total per mounting) .. .. .	1.25	1.25	1.25	.70
(b) (i) Elevating mass .. .. .	7.60	7.60	7.60	3.75
(ii) Training mass (mountings fitted with Marks I or II fuze setting machines or hand fuze setting turntables, etc.) .. .. .	13.65	14.50	13.40	8.55
(iii) Training mass (mountings fitted with Mark V fuze setting machines) .. .. .	13.95	14.85	—	—
(iv) Total recoiling mass .. .. .	5.80	5.80	5.80	2.90
(c) (i) Total weight (mountings fitted with Marks I or II fuze setting machines or hand fuze setting turntables, etc.) .. .. .	14.30	15.20	14.15	9.85
(ii) Total weight (mountings fitted with Mark V fuze setting machines) .. .. .	14.60	15.50	—	—

**14. Ballistics**

(a) *Full Charge*

- (i) Initial muzzle velocity .. .. . 2,650 ft./sec.
- (ii) Weight of projectile .. .. . 35 lbs. 14 ozs.
- (iii) Weight of charge .. .. . 9 lbs. 0 ozs. 6 drs. (S.C. 103).
- (iv) Total weight of round .. .. . 63 lbs. 8 ozs.

(b) *Reduced Charge*

- (i) Initial muzzle velocity .. .. . 2,000 ft./sec.
- (ii) Weight of projectile .. .. . 35 lbs. 14 ozs.
- (iii) Weight of charge .. .. . 5 lbs. 1 oz. 11 drs. (S.C. 061).
- (iv) Total weight of round .. .. . 59 lbs. 9 ozs.



## 15. Positions of Centres of Gravity

## (a) Mark XVI\* Gun

- (i) With breech mechanism and loaded .. .. 56.83 in. from breech face.  
 (ii) With breech mechanism but unloaded .. .. 57.13 in. from breech face.  
 (iii) Without breech mechanism and unloaded .. .. 60.98 in. from breech face.

## (b) Mark XIX (all types) and Mark XX mountings, complete with guns

Centre of gravity is over the centre pivot.

## 16. Rifling of Mark XVI\* Gun

- (a) One turn in 30 calibres, 32 grooves.  
 (b) Probable life in E.F.C.s. of rifling—600.  
 (c) Series after which gun must be inspected—100 rounds.  
 (d) Provisional condemning limit of wear—0.248 in. at 1 in. from commencement of rifling.

## 17. Recoil and Run-Out Data

## (a) Recoil

- (i) Working (full charge) .. .. 15 in. { acceptable min. 14.5"  
 (ii) Metal to metal .. .. 16.5 in. { acceptable max. 15.5"  
 (iii) Reduced charge .. .. 8 in.

## (b) Recuperator

- (i) Initial charging pressure .. .. 970 lbs./sq. in.  
 (ii) Pressure after recoil .. .. 1,490 lbs./sq. in.  
 (iii) Packed back charging pressure .. .. 1,550 lbs./sq. in.  
 (iv) Percentage of recoil absorbed in recuperator .. 31 per cent.

## (c) Intensifier

- (i) Initial pressure on intensified side of piston .. 1,290 lbs./sq. in.  
 (ii) Pressure after recoil on intensified side of piston .. 1,990 lbs./sq. in.

- (d)—(i) Capacity of recoil system .. .. 

Mark XIX	Mark XX
20 pints	10 pints
(approx.)	(approx.)

 PER GUN. P. 221/42.  
 (ii) Composition of buffer liquid .. .. Equal parts of glycerine and saturated solution of lime, the solution being made with

Page 9. Paragraph 17 (d) (ii). After "distilled water" add:—

✓ "Oil O.M. 13 when modified control rings (Modification No. 85) are fitted."

(G. 04086/50.—A.F.O. P. 9/51.)

## (e) Test Pressures

- (i) Recoil cylinder .. .. 8,000 lbs./sq. in.  
 (ii) Recoil cylinder, assembled .. .. 4,000 lbs./sq. in.  
 (iii) Compensating tank .. .. 40 lbs./sq. in.  
 (iv) Recuperator .. .. 3,000 lbs./sq. in.  
 (v) Intensifier .. .. 4,000 lbs./sq. in.

## 18. Forces on Firing

## (a) Forces of Recoil

- |  | Mark XIX<br>Tons | Mark XX<br>Tons |
|--|------------------|-----------------|
| (i) With guns horizontal .. ..                     | 36 (2 guns)      | 18              |
| (ii) With guns at 80° elevation .. ..              | 42 (2 guns)      | 21              |
| (iii) Reduced charge firing, guns horizontal .. .. | 30 (2 guns)      | 15              |

## (b) Deck Blows

- |   |    |    |
|---|----|----|
| (i) Maximum upward lift at front of base plate ..   | 29 | 15 |
| (ii) Maximum downward blow at rear of base plate .. | 50 | 26 |

## 19. Elevating Gear Details

- (a) Maximum elevation .. .. 80°.  
 (b) Maximum depression .. .. 10°.  
 (c) One revolution of the handles elevates the guns 3°.  
 (d) Type of elevating receiver:—

## Bottom drive—

- C, Marks III\* and VI, duplex.  
 C, Marks IV, IV\*, V, V\* and IX, single.  
 F, Marks I, II and III, single.  
 CM, Marks I and I\*, single.

## Back drive requiring adaptor bracket and bevels—

- C, Marks I, II and II\*, single.

- |   | Mark XIX<br>Tons | Mark XX<br>Tons |
|---|------------------|-----------------|
| (e) Minimum force required at teeth of elevating arc to make friction plates render .. .. | 4.5              | 2.25            |



**20. Training Gear Details**

(a) Maximum angle of training .. .. . 340° or 670° (according to type of stops fitted).

(b) One revolution of the handles trains the mounting 4°.

(c) Type of training receiver :—

*Bottom drive—*

C, Marks III and VI, duplex.

C, Marks IV, IV\*, V and V\*, single.

CM, Marks I and I\*, single.

F, Mark I.

*Back drive requiring adaptor bracket and bevels—*

C, Marks I, II or II\*.

*Back drive requiring adaptor bracket and spur gearing.*

Small type (modified).

(d) Minimum force required at training rack to make friction plates render .. .. .

**Mark XIX**

Tons

7.2

**Mark XX**

Tons

.85

**21. Training Base**

(a) Holding down bolts

(i) Number .. .. . 28

(ii) Diameter .. .. . .875 in.

(iii) Pitch circle diameter .. .. . 71.5 in.

*Cheese Head*

*Screws*

*Hexagon*

*Bolts*

28

1.25 in.

75 in.

(b) Clip clearances .. .. . .01 in. minimum.

.02 in. maximum.

(c) Training rollers

(i) Number .. .. . 50.

(ii) Flange clearance on lower racer base plate .. .003 minimum.

.007 maximum.

**22. Cradle**

(a) Clearance of gun in bearing strips in cradle .. .009 in. minimum.

.02 in. maximum.

.02 in.

Page 10. After paragraphs 23 (b) add :—

**23 (1) Safety Firing Switch Gear.**

(a) Designed limits of operation .. .. . 10° depression, 80° elevation

(b) Type of Interceptor .. .. . Mark 4 modified or Mark 6.

(G. 07778/48—A.F.O. P.71/50.)

**24. Sighting Gear**

(a) Gearing constants

(i) Range .. .. . 10.2273 to 1.

(ii) Lateral deflection .. .. . 17.4924 to 1 (1 unit equals 6 minutes of deflection).

(b) Range dial graduations

(i) Full Charge .. .. . Every 25 ft./sec. of M.V. between 2,650 ft./sec. and 2,500 ft./sec. Projectile 6 c.r.h. (Table No. 370). Maximum range, 18,000 yards.

(ii) Reduced Charge .. .. . Every 25 ft./sec. of M.V. between 2,000 ft./sec. and 1,875 ft./sec. Projectile 6 c.r.h. (Table No. 439). Maximum range, 13,500 yards.

(c) Deflection dial graduations .. .. . 0 to 100 units (0° to 10°), right or left.

(d) Drift is corrected automatically by gearing, drift constant 120, amount of drift at 30° T.E. 1°—9'.3"

(e) Travel of sight .. .. . 30° below and 5° above centre line of gun.

(f) Adjustments

(i) For change in M.V. .. .. . Ship appropriate dial.

(ii) For reduced charge firing .. .. . Ship reduced charge cams, crankarms and appropriate dials.

(g) Barrage Sights

(i) Aim-off speeds .. .. . Inner ring, 100 knots.  
Outer ring, 200 knots.



**25. Hauling Back Gear**

(a) Test load (assembled) . . . . . 12 tons.

**26. Shield**

(a) Thickness . . . . . 125 in.

(b) Material . . . . . "D" quality steel plate.

27 to 32.

**CH. I. SECTION 2—LUBRICATION****Plate 39 and 40.**

33. This plate is a lubrication diagram for all parts of the mounting. The colours used on the diagrams to indicate the frequency of lubrication are for guidance only. No hard and fast rule can be laid down as to the frequency of lubrication.

Page 11. After paragraph 33 add:—

33A. Lubrication of safety firing switch gear is shown on plate 24A.

(G. 07778/48.—A.F.O. P.71/50.)

**Grease**

34. This form of lubrication is extensively employed. As a rule the grease is applied to the working surfaces through a nipple, by means of a grease gun, but in some places spring feed lubricators are used. Grease is particularly suitable for intermittent loads. Apart from its lubricating properties it serves to exclude water and moisture from bearings and other working parts exposed to weather and acts as a preservative.

35. It is important to remember that grease will always take the easiest passage. Thus, if two or more bearings are greased from the same lubricator there will be a tendency for the bearing nearest the lubricator to receive most of the grease. Similarly, if a very long bearing is fed from a single lubricator most of the grease is likely to pass towards the end of the bearing nearest the lubricator or along that part of the bearing which has the largest clearance. In the course of time this tendency is accentuated by the grease in those grooves which, owing to their size or length, offer the greatest resistance to the entry of fresh lubricant, becoming hard and eventually clogging the passages completely. For these reasons it is usual, wherever possible, to employ a separate grease nipple or lubricator to serve each bearing or slide.

36. It is necessary to ensure that all working parts receive attention at regular intervals, and are adequately lubricated. In normal circumstances, however, grease is retained as a working film for long periods and application of a grease gun to a bearing which is already fully charged will only result in forcing out and wasting serviceable lubricant. On the other hand it does not necessarily follow, for the reasons stated above, that because grease is seen exuding from one part of a bearing, all working surfaces charged from the same lubricator are being sufficiently greased. Care should therefore be exercised when working parts are stripped for examination to note whether the lubricating arrangements have been functioning efficiently so that, if necessary, steps may be taken to examine the parts more frequently in future. Before closing up again all old grease should be removed from the grease grooves and passages and fresh grease applied.

37. The use of grease is avoided as far as possible for small totally enclosed parts such as spring plungers as it is liable to choke the boxes and make the gear work sluggishly.

**Oil Baths**

38. Wherever possible, spur, bevel and worm gearing is totally enclosed in a box which is kept partly flooded with Admiralty Special Mineral Oil. With this arrangement some of the parts are totally immersed in oil while those above the oil level are lubricated by the oil flung off the gears as they rotate.

Each oil box is usually fitted with a filling plug and an oil level plug, but occasionally one plug serves both purposes.

Oil is prevented from leaking out of the boxes where the shafts pass through by means of felt rings, often combined with a grease seal, or by patent oil seals which are self-contained units embodying a hat leather, the lip of which is pressed on to the shaft by a spring.

**Oilers and Oil Cups**

39. Lightly loaded parts, particularly in connection with instruments, such as drives for director and fire control gear, are usually designed for lubrication by oiling.

40. Oilers or oil cups are also fitted in places where it would be impracticable, on account of accessibility, to connect a greaser to the part requiring lubrication, e.g., training roller axles, or where several pairs of surfaces, possibly separated by some distance, must be fed from the same lubricator.



## CHAPTER II

### SECTION 1—THE GUN

#### Plate 6

46. The gun is of all steel construction. It consists of a **loose barrel** (autofrettaged), **jacket**, **removable breech ring** and **sealing collar**.

#### LOOSE BARREL

47. The barrel is rifled on the polygroove system with 32 grooves having a uniform twist of one turn in 30 calibres. The length of bore is 45 calibres, i.e. 15 ft.

#### JACKET

48. The jacket is screwed externally at the rear end with interrupted threads to receive the breech ring, and at the front end is screwed to take the sealing collar.

On assembly the loose barrel is inserted in the jacket until a shoulder at the rear end of the barrel seats itself in a ring of increased diameter at the rear end of the jacket. There is a clearance between the exterior of the barrel and the interior of the jacket and the barrel is prevented from rotating by two **securing screws**.

Watertightness between the fore end of the jacket and the barrel is obtained by asbestos rings compressed within the **sealing**

#### BREECH RING

49. The breech ring is screwed to those of the jacket. On assembly portions in line with the interrupted position. It is then rotated through vertical axis of the breech ring entering is then locked to the jacket by

The breech ring is machined to receive the various mechanism components and on its upper surface is the clinometer plane.

\* "To ensure freedom of movement on stripping, the collar should be quarterly (using wrench, sealing collar) every six months in capital ships, cruisers and aircraft carriers and every three months in other ships. Any corrosion should be removed and the collar then should be well greased and re-assembled with fresh packing if necessary. Two lengths of asbestos packing steam gland, for superheated steam, Pattern 26, are to be used, each length being formed into a ring and scarf-jointed, the joints of the two rings being diametrically opposite when assembled." (This amendment embodies A.F.O. 2501/43.) (See rear end view).

Page 12. Paragraphs 50 and 51 (as inserted by A.F.O. P.278/48.) Delete and substitute:—

#### Inspection.

50. Particulars regarding the probable life, inspection series, condemning limits, breech mechanism clearances and the service life and inspection of breech rings are given in B.R. 291.

For procedure for changing barrels see Chapter 6, Section 4.

51-57.

52-57."

(G. 3010/48.—A.F.O. P.374/49.)

## CH. II. SECTION 2—THE BREECH MECHANISM

#### Plates 7, 8, 9, 10, 11

58. The breech mechanism of the 4-in. Mark XVI\* gun is of the plain surface block type, arranged to slide vertically in the breech end of the gun. The breech block with its components is interchangeable for both left and right guns but the breech mechanism lever is handed and is mounted on the actuating shafts at the left and right-hand sides of the respective breech ends. The remainder of the gear with few exceptions is interchangeable.

59. The firing mechanism is of the combined electric and percussion type in which the percussion striker is cocked during the opening of the breech and remains cocked, unless percussion fire has been employed.

When a new part is required the size and Mark of the gun, i.e., 4-in. Mark XVI\*, the index number and the description as given in the Schedule are to be used on the demand note. (See Appendix II.)

60. The mechanism consists of the following principal parts:—

- Breech Block.**
- Actuating Shaft with Lever.**
- Crank.**
- Extractor.**
- Catches Retaining Breech Block Open.**



Counterbalance and Buffer.  
 Breech Mechanism Lever.  
 Breech Mechanism Lever Stop Bracket.  
 Firing Mechanism.  
 Cocking and Retracting Gear.  
 Safety and Recocking Gear.

#### THE BREECH BLOCK

61. The **breech block** is of the vertical sliding block type with a plain guide on both sides. These guides slide in corresponding grooves in the breech ring, the grooves being slightly inclined to give a forward movement to the block in closing.

This ensures that the cartridge case is forced home on closing and also prevents undue rubbing between the breech block and the head of the case in opening.

62. The upper centre part of the block is curved to clear the cartridge when loading and the upper front face is bevelled to assist the seating of the cartridge case. In the centre of the curved cutting is the **preserving screw** to protect the hole for the lifting eye. Just above the curved surface on the left-hand side of the block three **preserving screws** are fitted to protect the holes that receive the screws of the arm actuating extractor for the sub-calibre gun.

On the left-hand side of the block a curved groove is provided to take the **crank sliding block**.

63. On the gun axis the block is bored to take the **firing case**, which is retained by interrupted collars at the rear of the bore. The front of the bore is screwed to receive the **firing hole bush**.

64. On the left-hand side of the block a hole is provided for the **firing plunger** and on the right-hand side is a stepped hole to take the **breech block inner contact bush**. The inside lower part of the block is hollowed out and prepared to receive the **cocking, retracting and actuating lever**.

At the rear end of the block is a vertical hole for the **recocking bar** and towards the lower edge a stepped hole is provided for the **breech block outer contact**.

65. The front face of the block is cut away to receive the **extractor** and the **catches retaining breech block open**, radial surfaces being provided at the upper end of the block to engage these catches when the breech is open.

#### THE ACTUATING SHAFT. (Plate 9)

66. The **actuating shaft** consists of a long spindle of one diameter with a flanged head. The spindle has three keyways cut into it and they engage with corresponding keys on the **crank** and **collar** pivoted in bushed bearings in the lugs at the bottom of the breech ring. The spindle extends outwards from the left-hand side of the breech ring on the left gun and on the opposite side on the right gun. The extended portion of the spindle carries the **rack pinion** (housed in the **B.M. lever**) and **actuating shaft lever**. The pinion and actuating shaft lever are keyed to the actuating shaft, the former being retained by the flanged head. The spindle of the actuating shaft passes through the **sleeve** that retains the crank and collar and is kept in position by the **locking screw** in the sleeve.

#### THE ACTUATING SHAFT LEVER

67. The actuating shaft lever, which is keyed to the actuating shaft, is housed between the side of the breech ring and the breech mechanism lever bearing.

68. It is provided with a double eye for connecting to one end of the **link actuating breech mechanism**. The latter is connected at its other end to the **cam actuating breech mechanism**. The cam is operated by the **crank arm** of the **semi-automatic gear** on the mounting and during the run-out of the gun is rotated to open the breech through the medium of the link and actuating shaft lever.

#### THE CRANK. (Plate 10)

69. The crank which is keyed to the actuating shaft rotates in the bushed bearing in the left-hand lug at the bottom of the breech ring.

It has a projecting arm with crank pin for operating the block; the crank pin engages with the sliding block which in turn slides in the curved groove provided in the left-hand side of the breech block.

70. Because the crank movement passes beyond the dead centre a locking point is obtained when the breech is closed. Maximum power is obtained when commencing to open the breech and when seating the cartridge, and shock when operating semi-automatically is practically eliminated.

In the closed position a stop surface at the front of the crank abuts on the chamber face of the breech ring.

#### THE EXTRACTOR. (Plate 11)

71. The extractor is of the one-piece rocking type, the axis (which bridges the arm) engaging in a slot in the breech end. The arms are arranged to rock on the breech end giving powerful initial wedging action, after which the axis pivots in the breech end to give rapid ejection. The toes of the extractor engage the rim of the cartridge case, while the heels are actuated by inclined cuttings in the breech block.



**CATCHES RETAINING BREECH BLOCK OPEN. (Plate 9)**

72. These catches are spring controlled levers pivoted on axis pins mounted in the breech ring on the left and right-hand side of the loading gap. The axis pins are retained by fixing screws in the breech ring.

73. When the breech is opened, the catches are brought out by the arms of the extractor and held out by their respective spring plungers.

74. The catches thus prevent the closing of the breech block beyond the loading position until a cartridge is inserted.

75. On loading the flange of the cartridge engages with the lips of the catches, thereby moving them out of the path of the breech block so that the breech may be closed.

**COUNTERBALANCE AND BUFFER. (Plate 9)**

76. The counterbalance has a fourfold purpose, viz. :—

- (1) It limits the normal opening travel of the breech block.
- (2) It controls the weight of the falling breech block during the opening of the mechanism.
- (3) It assists the closing of the breech block.
- (4) It returns the breech block to loading position in Q.F. action, thus freeing the extractor and then carries it on to the cartridge retaining position on loading.

77. The counterbalance consists of the **rod, sleeve, spring** and **nut**. It is controlled in a vertical hole in the right-hand side of the breech ring and is secured to the **breech block yoke** by the nut.

78. The breech block yoke, which is permanently riveted to the breech block, has a spherical recessed seating for the head of the nut to allow for the slight rocking action of the counterbalance rod when the breech block is opening on the inclined guides.

79. The **buffer** provides a shock absorber when the breech is opened violently, as may occur in S.A. action.

80. It is contained in the bottom of the vertical hole for the counterbalance and consists of a **washer**, rectangular section **spring** and screwed **bush**.

81. In action the counterbalance sleeve is arrested on the buffer washer to limit the normal opening of the mechanism, overtravel of the block then compresses the buffer spring until movement is finally arrested by the washer stopping against the upper face of the bush.

**THE BREECH MECHANISM LEVER. (Plate 9)**

82. The breech mechanism lever is handed and is fitted on the left-hand side of the left gun and on the opposite side on the right gun. It is pivoted on the rack pinion but free to revolve relative to it.

83. The outer side of the B.M. lever is bored out to receive the **rack** and the **breech block actuating spring**.

84. The spring is retained by a screw **cap** with **bearing disc**, the cap being locked by a check screw; the compression of the spring can be adjusted by the cap. *A DRILL MARK ON THE CAP INDICATES THE LIMIT OF SPRING ADJUSTMENT FOR DRILL.*

P 374/49.

85. The rack engages with the rack pinion so that relative movement between the actuating shaft and the B.M. lever will cause the actuating spring to be compressed.

86. Sliding in the B.M. lever is the **catch bar** which is operated by the catch bar actuating lever. The inner end of the catch bar, when moved towards the axis, engages in a recess in the actuating shaft lever.

87. The **spring plunger**, which is mounted in the catch bar, keeps the latter out of engagement.

88. The plunger is retained by a pin when the catch bar is removed from the B.M. lever.

89. When the catch bar is engaged with the actuating shaft lever any outward movement of the B.M. lever will rotate the actuating shaft, but the shaft can turn in the opening direction without moving the B.M. lever when the catch bar is disengaged. This latter action occurs in S.A. firing.

90. On the inside of the catch bar is a projection which engages with the **B.M. lever catch**. The latter, which locks the B.M. lever in the fully closed position, is pressed out of engagement with the pocket in the **B.M. lever stop bracket**, when the catch bar is moved by the catch bar actuating lever.

91. On the top side of the catch bar is a projection which abuts against the hook on the **B.M. lever latch** when the B.M. lever is 3° from being fully closed, thereby retaining the B.M. lever in this position. When the catch bar is fully operated by the catch bar actuating lever the projection on the bar is clear of the hook on the B.M. lever latch.

92. The catch bar actuating lever, which engages with the catch bar, is pivoted in the handle portion of the B.M. lever on an axis pin.

93. On the end of the arm of the B.M. lever is the **B.M. lever guide** which is permanently riveted to the B.M. lever. This guide is controlled in a cutting in the B.M. lever stop bracket and prevents side play of the top end of the B.M. lever when the latter is being finally closed.



94. The B.M. lever catch slides in a hole in the B.M. lever and is spring controlled. The upper end of the catch enters a pocket in the B.M. lever stop bracket to lock the B.M. lever in the fully closed position. The lower end of the catch engages with the inner projection on the catch bar.

95. Below the B.M. lever catch is the **catch spring bearing guide** which bears on the quadrant of the **locking lever**. When the catch spring bearing guide is on the upper surface of the quadrant, i.e., the S.A. position of locking lever, the B.M. lever catch abuts against the bearing guide and is therefore locked.

96. By rotating the locking lever to the Q.F. position, the catch spring bearing guide is bearing on the lower surface of the quadrant which allows relative movement of the B.M. lever catch to take place.

97. The locking lever is pivoted in the B.M. lever and consists of a spindle with a solid arm.

98. The spindle is cut away to form the quadrant which engages the catch spring bearing guide.

99. The arm contains the spring-operated **locking lever plunger and head**. The plunger enters pockets in the B.M. lever and retains the locking lever in either the S.A. or Q.F. position.

The plunger is freed from either pocket by withdrawing the head.

#### **THE B.M. LEVER STOP BRACKET. (Plate 9)**

100. The B.M. lever stop bracket fits into grooves in the breech ring and is secured by two fixing screws with locking plates. The side face of the bracket forms the stop for the B.M. lever in the locked position. The central portion of the bracket houses the gear that releases the B.M. lever catch and latch.

In the lower end of the bracket is the pocket for the B.M. lever catch which locks the B.M. lever in the closed position. On the side of this pocket is a bevelled surface for depressing the catch during the final closing to allow the catch to snap into its pocket.

101. Screwed into the stop face side of the bracket is the **axis stud** for the B.M. lever latch, the latter being retained by a nut with keep pin.

102. On the opposite side of the stop face is a preserving screw for protecting the hole that is provided for the axis stud when the bracket is fitted to the opposite hand breech ring.

103. The releasing gear consists of a **plunger, spring, collar, sleeve and link**. The plunger engages direct with the B.M. lever catch and through the link is connected with the B.M. lever latch.

104. The plunger is operated by the **thumb releasing B.M. lever** on the balance ring.

105. Should the breech not be fully closed by the actuating spring in any circumstances, then the B.M. lever catch and latch can be disengaged from the B.M. lever by applying pressure on the thumb piece. The B.M. lever can then be brought to that position at which grasping the lever handle will engage the catch bar with the actuating shaft lever, and closing of the breech can be completed by means of the B.M. lever, as in hand operation.

106. The B.M. lever latch pivoted on the bracket retains the B.M. lever at 3° from the fully closed position through the medium of the hook on the latch and the top projection on the catch bar. The latch is controlled through the link and releasing plunger by the spring, and when the B.M. lever is closing the latch is pressed upwards by the top projection on the catch to snap behind the projection and thus retain the B.M. lever just before finally reaching the closed position.

107. The object of this latch is to ensure that the B.M. lever is retained against rotation during firing, since during the final 2° rotation of the B.M. lever the **needle** of the firing mechanism is in electrical contact with the primer in the cartridge case.

#### **HOUSING THE BREECH MECHANISM LEVER**

108. The B.M. lever can be housed, when the breech is open, by releasing the catch bar actuating lever (thereby disconnecting the actuating shaft lever from the B.M. lever) and forcing home the B.M. lever until it is held by the B.M. lever catch snapping into its pocket in the B.M. lever stop bracket. This will put the actuating spring into compression, a relative movement between the rack and the pinion having taken place.

The breech block will also close slightly at first until held by the retaining catches.

As soon as the catches are released by the next round the force exerted on the rack by the B.M. lever actuating spring will rotate the actuating shaft and close the breech.

109. The initial compression on the actuating spring is 480 lbs. and the maximum working compression is 1,000 lbs.

#### **CHANGING FROM "S.A." TO "Q.F." WITH THE BREECH BLOCK OPEN.**

110. As the breech block has to be lifted vertically a very strong spring is required. This spring is fully compressed when the block is open and the B.M. lever housed.

111. If the B.M. lever is then unlocked from the housed position it will fly to the open position with great violence and will severely injure anyone in its path.



112. Two levers are pivoted on the steadying handle, the top lever being provided with a thumb-piece while the bottom lever engages with the top end of the plunger which releases the B.M. lever catch. When the thumb-piece is pressed, the plunger is forced down and releases the catch from its stop bracket. The B.M. lever is thus unlocked and will fly open under the action of the spring. **The thumb-piece should not be pressed, therefore, till the breechworker has taken the thrust of the B.M. lever.**

113. The following procedure should be adopted :—

- (i) Set the locking lever to "Q.F."
- (ii) Grasp the B.M. lever firmly with one hand and press forward to take the thrust of the spring.
- (iii) Grasp the steadying handle firmly with the other hand, and press the thumb-piece, easing the B.M. lever.

These loads can be reduced by any amount up to 180 lbs. by merely slacking back the cap.

## THE FIRING MECHANISM

### Plates 10, 11

114. In general the percussion gear consists of a **trigger** and **firing bar** mounted on top of the breech ring, a **firing lever** pivoted in the breech ring and a **firing plunger** in the breech block that connects with the **trigger sear** in the firing case. The firing case also carries the **striker** and **needle block** and is removable as a unit.

115. The safety gear provides a "safe" retraction of the needle by acting through the recocking and retracting gear when the **safety lever** is put to "SAFE" and the recocking gear permits of recocking the percussion striker without opening the breech.

## PARTS OF THE FIRING MECHANISM

116. **FIRING CASE.**—This is a cylindrical body that fits into the axial bore of the breech block, where it is held by interrupted collars and locked by a spring hinged **catch**. This catch normally lies flat in a recess in the breech block and cannot be laid down unless the firing case is home.

117. The firing case carries the trigger sear with its axis pin and return **plunger** which are housed in the side of the case.

118. The firing case also carries the needle block and striker details, which are retained by the **cover**, the latter being locked in place by the hinged catch.

119. The firing case cannot be removed from the breech block unless the needle has been retracted through the agency of the safety lever to the "SAFE" position and the striker also withdrawn to the fully cocked position.

120. When the needle is retracted to the "SAFE" position, the recocking bar is automatically withdrawn from a pocket in the flange of the firing case.

121. When the striker is cocked, either by having previously opened the breech or through the recocking gear, a nib on the trigger sear is clear of the shoulder of the rear interrupted collar and thus allows the firing case to be rotated for removal.

122. **NEEDLE BLOCK.**—This is a cylindrical body in two parts, **Part I** carries the needle with **insulating washer** and **bush**; **contact piece** with **insulating bush** and **securing nut**. The contact piece makes electrical contact with the **breech block inner contact bolt**.

123. The **needle block, Part II**, is screwed to Part I and secured by a fixing screw. The central portion of Part II has a long stem which supports the needle block spring, and on the lower left-hand side is a projection which is engaged by the retracting lever to give safe withdrawal of the needle before the breech block moves in opening. This projection, together with a similar projection on the opposite side of the striker, forms a key to prevent rotation of the needle guide block. In order to obviate the possibility of fracture, Part II needle blocks in Q.F., 4-in., Mark XVI\* guns will be modified by drilling out the stem and when so modified are known as Mark I\*.

124. The **needle block spring** bears against a recessed seating in the needle block Part II to press the needle forward on to the primer. The other end of the spring is housed in the **striker spring bearing guide**.

125. **STRIKER.**—This is a cylindrical body containing the **striker spring**. The latter is supported on the striker spring bearing guide, which is held in the firing case cover by the pressure of the striker spring. A new pattern striker spring, known as the Mark IV, came into supply in 1941.

126. The striker has a projection on the lower right-hand side against which the cocking lever engages when the striker is being cocked. This projection extends rearwards and forms a key in the firing case body to prevent rotation of the striker.

127. A cutting at right angles to this key provides two shoulders for engagement with the trigger sear.



128. The rear shoulder engages with the sear to hold the striker in the cocked position, while the front shoulder causes positive engagement of the sear with the striker on withdrawal of the latter to the overcocked position.

129. The striker effects percussion firing by its hammer action on the needle block, the needle of which is always in contact with the primer for electric firing.

130. **FIRING PLUNGER.**—This plunger, with its details, is housed on the left-hand side of the breech block.

131. It connects the trigger sear with the firing lever and is normally spring returned. Should it fail to return after firing the trigger sear automatically pushes back the firing plunger during the overcock of the striker.

132. **FIRING LEVER.**—This lever is housed in a recess in the left-hand side of the breech ring and is pivoted on the **firing lever axis pin**.

Its lower end engages the roller of the firing plunger and is provided with a bevelled projection. The upper end of the firing lever is provided with a roller that engages in a groove in the trigger.

133. The bevelled projection on the lower end is opposite a corresponding cutting in the breech block when the latter is closed and thus only permits rotation of the firing lever to release the trigger sear in the closed position of breech block.

134. When the breech block is opening, the bevel in the cutting engages the bevelled projection and positively forces back the firing lever to its normal position if the lever has not returned after firing.

135. **TRIGGER AND FIRING BAR.**—These details are mounted on the top of the breech ring, the trigger being pivoted on a stud screwed into the top left-hand side of the breech ring. The bar is coupled to the trigger and is guided in a stud screwed into the top right-hand side of the breech ring. A spring plunger contained in the bar and bearing against the stud normally returns the firing gear, but the gear is positively returned when the breech block is opening through the agency of the firing lever.

136. On the left gun the trigger is coupled by a link and lever to the left-hand **palm lever** of the firing gear on the balance ring and on the right gun the trigger bar is engaged by a lever connected up with the right-hand palm lever.

137. The palm lever is the normal means of operating the firing gear, but provision is also made on the trigger and firing bar for firing by means of a lanyard on the left and right guns respectively.

## COCKING AND RETRACTING GEAR.

### Plate 10

138. **ACTUATING LEVER FOR COCKING AND RETRACTING LEVER.**—This lever is pivoted in the rear part of the hollowed portion of the breech block on the cocking and retracting crank spindle and has three separate arms.

139. The vertical arm carries a roller which engages with the cocking lever and also has an extension which engages with the roller on the retracting lever.

140. The lower extremity of this projection is radial and rides over the retracting lever roller during the continued action of the actuating lever to cock the lock.

141. The rear arm engages in a slot in the recocking bar containing the return spring. The front arm engages on the sides of the cocking and retracting levers to return these two levers to their normal position through the agency of the spring.

142. **COCKING LEVER.**—This lever is pivoted in the front part of the hollowed portion of the breech block on the spindle which also carries the retracting lever. This spindle has an elongated head fitting into the breech block and is retained by the cocking crank. The upper arm of the cocking lever engages the projection on the striker and the lower arm engages the roller on the actuating lever.

143. **RETRACTING LEVER.**—This is a lever pivoted as above, the upper arm engages the projection on the needle and the lower arm carries a roller which engages with the toe of the extension on the actuating lever.

144. **COCKING CRANK AND RETRACTION CRANK.**—These cranks are pivoted in the breech block on either side of the actuating lever. The cranks are coupled by claws with the actuating lever. The **cocking crank** carries a **roller** which engages with the **cocking surface** in the breech ring when the breech block is opening to complete the cocking of the striker.

145. The **retracting crank** carries a large roller that is actuated by the crank sliding block during the initial movement of the crank on the actuating shaft.

146. **RECOCKING BAR.**—This is a cylindrical body, sliding vertically in the rear end of the breech block and houses the return spring for the actuating lever. Its upper end enters a pocket in the firing case from which it is withdrawn when the needle is retracted to the "SAFE" position.

The upper end is also slotted to receive the rear arm of the actuating lever.

The lower end of the recocking bar is provided with a lug that engages the **recocking bar actuating lever** on the **recocking shaft**.



### SAFETY AND RECOCKING GEAR. (Plate 9)

147. This gear is fitted on the same side of the breech ring as the breech mechanism lever and consists of the safety lever, **intermediate safety lever**, **recocking shaft**, **recocking shaft actuating lever** and **recocking bar actuating lever**. The gear is interchangeable for left and right guns with the exception of the safety lever which is handed.

148. The safety lever is pivoted in the side of the breech ring and retained by a screw. The arm of the lever is provided with a spring plunger which enters pockets in the breech ring and retains the lever in either the "SAFE" or "FIRE" position. The plunger is freed from either pocket by withdrawing the head secured to the plunger. On the outside of the axis of the safety lever is a boss containing a cam-shaped cutting that engages with the toe of the intermediate safety lever.

149. The intermediate safety lever is pivoted on an axis pin fitted into the side of the breech ring. The pin is retained by a screw underneath the lower end of the **loading handle**.

150. The upper arm of the intermediate safety lever is cylindrical to accommodate a tool for rotating the lever to recock the striker. The lower arm is provided with a toe that engages with the cam cutting in the boss of the safety lever. The front surface of this arm is cam-shaped and engages with the roller on the recocking shaft actuating lever.

151. The recocking shaft consists of a long spindle with a flanged head and is pivoted in a hole bored right through the lower rear end of the breech ring. The spindle has three keyways cut in it and they engage with corresponding keys on the recocking shaft actuating lever and recocking bar actuating lever, the recocking shaft actuating lever being retained by the flanged head of the shaft, the latter being secured by a nut with keep pin on the opposite end.

152. The recocking shaft actuating lever is keyed to the shaft on the side of the breech ring and on its upper arm carries a roller which engages with the cam surface on the intermediate safety lever.

153. The lower arm is provided with a spring plunger to keep the gear under control.

154. The recocking bar actuating lever is keyed to the actuating shaft and lies in a cutting at the bottom of the vertical centre line of the breech ring. Its arm engages with the lug on the recocking bar.

155. When the safety lever is rotated to the "SAFE" position the cam-shaped cutting engages with the toe of the intermediate safety lever to rotate the latter.

156. This movement (through the agency of the recocking gear, actuating lever, retracting and cocking levers) withdraws the needle and striker to a "safe" position.

### CONTACTS FOR ELECTRIC FIRING.

#### Plate 10

157. These parts which provide the necessary circuit to the contact piece of the needle block are three in number.

(1) **THE INNER BREECH BLOCK CONTACT.**—This is a bolt unit provided with insulation and controlled by a spring. It is mounted in a bush in a pocket in the right-hand side of the breech block, where it is retained by the **cover** which is dovetailed into the breech block and secured by a screw. The cover is freed by screwing the latter inwards. A cable passing through a hole in the breech block connects to the **outer breech block contact bolt**. The cable is held by a clip and screw.

(2) **THE OUTER BREECH BLOCK CONTACT.**—This is a bolt unit provided with insulation and mounted in the retaining sheath under control of a spring. The retaining sheath is housed in a hole in the lower rear part of the breech block.

It makes contact with the breech ring contact bolt when the breech is closed.

(3) **THE BREECH RING CONTACT BOLT.**—This is a bolt with nuts and insulation fitted in a recessed hole in the lower rear part of the breech ring. The recess is provided with a dovetailed cover and fixing screw similar to the cover of the inner breech block contact pocket.

The supply cable from the interceptor is connected by the terminal nuts on the bolt.

### LUBRICATION.

158. Two Enot's Nipples in B.M. lever. (One nipple on the side of the lever for lubricating rack and one nipple on the boss for lubricating B.M. lever bearing.)

Two Enot's Nipples in Breech Ring. (One on each lug for lubricating the crank bearing and actuating shaft collar bearing respectively.)

### ACTION OF THE MECHANISM.

#### Plates 8 and 9

#### OPENING THE BREECH SEMI-AUTOMATICALLY

159. As the gun runs out after recoil the **cam actuating breech mechanism** engages the **roller** on the **crank arm** of the **semi-automatic gear** on the mounting and causes the cam to rotate. The cam in turn, through the **link actuating breech mechanism**, rotates the **actuating shaft lever** and causes the **actuating shaft** to revolve, the latter thus rotating the **crank** to open the breech.



160. During this movement the **rack pinion** is also rotated, and acting on the **rack** in the casing of the **B.M. lever** compresses the **breech block actuating spring**.

161. The **B.M. lever** during this action is locked to the breech ring by the **B.M. lever catch**.

162. At the commencement of the crank rotation, and until the crank pin passes over the dead centre by an amount equal to the overlocking movement, no actual displacement of the **breech block** occurs. During this idle travel of the crank, the corner of the **sliding block** bears on the **retracting crank roller** and rotates the **retracting crank**. This action, through the medium of the **actuating** and **retracting levers**, withdraws the needle within the face of the breech block.

163. As the opening of the breech continues the **cocking crank roller** engages the **cocking surface** in the breech ring and rotates the **cocking crank**. This action causes further rotation of the actuating lever to take place and through the medium of the **cocking lever** withdraws and cocks the **striker**. During the additional movement of the actuating lever a radial surface on its lower extremity rides over the roller on the retracting lever and thus retains the latter in the retracted position whilst the breech is opening. As the breech block approaches the fully open position, the curved inclined cuttings in the breech block come into engagement with the heels of the **extractor** and, rocking the extractor arms on the gun, forcibly wedge the cartridge case out of the chamber. At the end of this wedging action the extractor fulcrums on its axis and the final movement of the breech block rapidly ejects the case. During the opening of the breech block the **counterbalance spring** has been compressed and on reaching the normal fully open position the **buffer spring** comes into action. This latter spring permits a small overtravel of the breech block, during which the energy stored in rapid opening can be absorbed before a metal to metal stop is reached.

164. As the breech block is returned from the fully open position by the breech block actuating spring and the counterbalance spring (the latter being the return medium for Q.F. working), the block is arrested at the loading position by the **catches retaining breech block open**. The latter are brought into the path of the block as the case is ejected. In the loading position the extractor is freed for loading.

165. On loading, the rim of the cartridge engages with the lips on the extractor and with the catches retaining breech block open, forcing them forward until the catches are disengaged from the breech block and thereby allowing the latter to close.

166. **FOR QUICK FIRING**.—The S.A. crank arm is put out of action by rotating it to the Q.F. position and the mechanism is operated by the **B.M. lever**.

167. When the handle of the **B.M. lever** is grasped the **catch bar actuating lever** pushes the **catch bar** into the recess in the **actuating shaft lever**. This locks the **B.M. lever** to the **actuating shaft**. At the same time the **catch bar** depresses the **B.M. lever catch** from its retaining pocket in the **B.M. lever stop bracket** on the breech ring. Also, the top projection on the catch bar is withdrawn clear of the hook on the **B.M. lever latch**.

Movement of the **B.M. lever** will then rotate the actuating shaft and open the breech.

168. A **loading handle** is provided on the side of the breech ring adjacent to the **B.M. lever** to assist the loading number when ramming the round in the breech.

## STRIPPING AND ASSEMBLY

### 169. BREECH AND FIRING MECHANISM

- (1) Set **safety lever** at "Safe" and cock the **striker** by means of the **recocking gear** if the striker is not already cocked.
- (2) Remove **firing case** complete and lay aside for subsequent dismantling.
- (3) Remove **counterbalance nut**.
- (4) Remove **preserving screw** in curved cutting in breech block and screw in lifting eye. Attach tackle to lifting eye to take the weight of the breech block.
- (5) Disconnect **link actuating breech mechanism** from **actuating shaft lever**.
- (6) Open breech by **B.M. lever** beyond the fully open position until the crank sliding block passes out of groove in breech block.
- (7) Remove **breech block**.
- (8) Remove **extractor**.
- (9) Slack back locking screw of **actuating shaft sleeve**.

Remove:—

- (10) **Actuating shaft**.
- (11) **B.M. lever** complete including **rack pinion**.
- (12) **Actuating shaft lever**.
- (13) **Actuating shaft sleeve**.
- (14) **Crank**.
- (15) **Actuating shaft collar**.



## 170. CATCHES RETAINING BREECH BLOCK OPEN

Remove:—

- (1) Fixing screws for axis pins.
- (2) **Axis pins.**
- (3) **Catches retaining breech block open.**
- (4) Pins and **spring plungers** from catches.

171. *FIRING MECHANISM IN BREECH BLOCK.*—This can be stripped and assembled most easily with the breech block face downwards on the bench.

Remove:—

- (1) Firing plunger retaining pin.
- (2) **Firing plunger** and spring.
- (3) Retracting and cocking crank spindle nut.
- (4) Retracting and cocking crank spindle.
- (5) **Retracting crank.**
- (6) **Cocking crank.**
- (7) Retracting and cocking lever spindle.
- (8) **Retracting lever.**
- (9) **Cocking lever.**
- (10) **Actuating lever.**
- (11) Pin retaining recocking bar.
- (12) **Recocking bar, plug and spring.**

## 172. DETAILS OF FIRING CASE

Remove:—

- (1) Catch retaining pin by pressing in plug.
- (2) Plug, spring and plunger.
- (3) Catch lever hinge pin.
- (4) **Catch lever.**
- (5) Screw retaining trigger sear axis pin (slack back only).
- (6) Trigger sear axis pin.
- (7) **Trigger sear.**
- (8) **Cover with bearing guide and striker spring.**
- (9) **Striker.**
- (10) **Needle block spring.**
- (11) **Needle unit complete.**

*Note.*—The needle unit should not be disturbed except for replacement of a needle or insulation. The **trigger sear plunger** details which are retained by a dovetailed plate need not be removed if working freely.

## 173. FIRING MECHANISM ON BREECH RING

Remove:—

- (1) Nut on trigger axis stud at top of breech ring.
- (2) **Trigger.** (Note.—On left gun, first removing the connecting link of the firing gear on the balance ring.)
- (3) **Firing bar** complete with spring plunger. (Note.—On right gun first removing the connecting lever of the firing gear on the balance ring.)
- (4) **Firing lever axis pin.**
- (5) **Firing lever.**

## 174. SAFETY AND RECOCKING GEAR

Remove:—

- (1) Recocking shaft nut.
- (2) **Recocking shaft.**
- (3) **Recocking shaft actuating lever** complete with spring plunger. (Remove plunger and spring by unscrewing nut.)
- (4) **Recocking bar actuating lever.**
- (5) **Loading handle.**
- (6) Keep screw for intermediate safety lever axis pin.
- (7) Intermediate safety lever axis pin.
- (8) **Intermediate safety lever.**
- (9) Screw retaining safety lever.
- (10) **Safety lever** complete. (Remove plunger and spring by unscrewing head.)

## 175. ELECTRIC CONTACTS

These should not require dismantling in ordinary circumstances, but only for special cleaning or renewals.



## 176. BREECH BLOCK INNER CONTACT

- (1) Screw inward the screw in the right-hand side of the breech block.
- (2) Remove **cover**.
- (3) Slack off the terminal nuts on both inner and outer breech block contacts.
- (4) Draw out the cable.
- (5) Remove **breech block inner contact bush** complete with **bolt**, etc.

## 177. BREECH BLOCK OUTER CONTACT

Remove :—

- (1) Terminal nuts.
- (2) Retaining nut.
- (3) Insulating washer.
- (4) Collar.
- (5) Sheath with spring, insulating sleeve, insulating washer and bolt.

## 178. BREECH RING CONTACT

- (1) Screw inward the screw in the lower rear part of the breech ring.
- (2) Remove cover.
- (3) Slack off the terminal nuts.
- (4) Draw out the cable.
- (5) Remove retaining nut.
- (6) Remove **bolt**.
- (7) Remove insulating washers and insulating sleeve.

## 179. COUNTERBALANCE AND BUFFER

Remove complete unit by unscrewing **buffer bush**, separate the various parts on the bench if desired.

The removal of these parts is obvious.

## 180. DETAILS OF BREECH MECHANISM LEVER

Remove :—

- (1) **Rack pinion**.
- (2) **Cap** after releasing check screw.
- (3) **Actuating spring** with **bearing disc**.
- (4) **Rack**. (In re-assembling, screw in assembling rod in hole provided in pintle of rack to facilitate alignment of keys.)
- (5) Axis pin for catch bar actuating lever.
- (6) **Catch bar actuating lever**.
- (7) **Catch bar** complete by sliding towards handle of B.M. lever. (Remove **plunger** and spring by withdrawing retaining pin.)
- (8) **B.M. lever catch** with spring and **bearing guide**.
- (9) Locking lever nut.
- (10) Locking lever complete. (Remove **plunger** and **spring** by unscrewing **head**.)

## 181. DETAILS ON B.M. LEVER STOP BRACKET

Remove :—

## "PREVENTION OF MISSFIRES"

184. The following points as regards the routine maintenance of the breech

Page 21. Last line. Delete "185-189" and substitute :—

**BREECH MECHANISMS—DRILL PRECAUTIONS.**

185. To avoid damage to parts of the breech mechanism during drill, the following preparations for drill are to be made :—

- (a) Unship the firing case.
- (b) Ease back the cap on the breech mechanism lever to the drill mark on the cap. (This is to be done because otherwise, with the parts named in sub-paragraph (a) above removed, the speed of travel of the breech block would be excessive, with consequent damage to the mechanism.)

Note.—This limit must not be exceeded.

186. After drill, the breech mechanism is always to be stripped down and lubricated. Care must be taken to screw the cap back again to its normal position when re-assembling the gear, in order that the proper tension may be replaced on the spring for service working.

187-189.

(G. 02178/49.—A.F.O. P.374/49.)

(Previous amendment No. 17—A.F.O. P.559/48.)

breech is closed. If the bar is in its extreme uppermost position, it is direct evidence that the retracting bar is NOT holding the needle up. Conversely, if movement can be given to the recocking bar in an upward direction when the breech is closed it is certain that some defect connected with (c) or (d) has held the needle to the rear.

185-189. P.374/49

(G. 2298/42.—A.F.O. P.208/42.)



## CH. II. SECTION 3—THE SEMI-AUTOMATIC GEAR

## Plates 12, 13

190. Semi-Automatic Gear for full and reduced charge firing is supplied for each gun, and is designed to open the breech automatically during run-out.

191. The **crank arm bracket** is secured to a vertical facing formed on the side of the **cradle**. Its centre portion is of channel section, the walls providing a bearing for the **change-over lever spindle**.

192. The **retaining catch** at the rear end of the change-over lever engages in either of the two positions, Q.F. or S.A.

193. The **crank arm**, carrying a hardened steel **roller** at its lower end, rotates on the **change-over lever spindle**. This spindle is formed with a solid **key** which is positioned in a circumferential slot in the crank arm. This slot is elongated to permit movement between the crank arm and change-over lever when the former is tripping in semi-automatic action.

194. The upper end of the crank arm is formed as a toe which bears on the top of a spring **plunger**. In the semi-automatic position of the change-over lever this plunger by pressure on the toe holds the underside of the crank arm against a **stop** on the inside of the crank arm bracket (see Plate 11).

195. The actuating parts of the gear consist of a **cam** having two working surfaces, upper and lower, formed upon it. This cam pivots on the **cam bracket** which is secured to the side of the balance ring. An **actuating link** connects the cam to the **breech mechanism actuating shaft lever** which operates the **breech mechanism crank**.

## ACTION OF THE SEMI-AUTOMATIC GEAR. Plate 13

196. The action of the cam and the crank arm roller during recoil and run-out is illustrated by the diagrams on this plate. The cam, cam bracket and balance ring travel bodily with the gun.

## RECOIL

197. When the gun recoils the cam travels bodily to the rear. The upper surface of the cam makes contact with the roller, the latter rides up the sloping surface of the cam and causes the crank arm to rotate clockwise, thus compressing the **plunger spring**. Should this action be violent and over-run the plunger spring, the **buffer spring** comes into action and absorbs any shock. (see Plate 10.)

As soon as the cam has passed clear of the roller, the plunger spring returns the crank arm to its normal position.

## RUN-OUT

198. When the gun runs out the lower surface of the cam comes into contact with the roller. As the crank arm is now hard against its stop, the cam is forced to rotate clockwise, pulling the actuating link forward and operates the breech mechanism. The cam continues to rotate until the heel of the cam rides over the top of the roller. The roller slides through the gap in the cam, and the breech mechanism is open in the loading position. On the insertion of a new round the breech block closes and automatically returns the cam to its normal position.

## QUICK-FIRING ACTION

199. When the change-over lever is moved to the quick firing position, the crank arm is rotated anti-clockwise to a position in which the roller is well clear of the path of the cam during recoil and run-out. The breech block has therefore to be opened by hand by the **breech mechanism lever**.

## TO CHANGE REDUCED AND FULL CHARGE SEMI-AUTOMATIC GEAR

- 200—(1) Withdraw the split pin from the **retaining catch axis pin** and remove both.
- (2) Disconnect the **actuating link** from the **cam** by withdrawing the split pin from the **link axis pin**, and remove the latter.
- (3) Rotate the **change-over lever** clockwise until arrested by the **stop** on the **crank arm bracket**.
- (4) Insert a tommy bar through the elongated hole in the outer wall of the bracket and allow the flats on the end of the bar to bear on the top of the **plunger**.
- (5) Force the tommy bar up and depress the **plunger**, and at the same time withdraw the **change-over lever** outwards. (Two men will be required to perform this operation.)
- (6) Remove the tommy bar.
- (7) Withdraw the **crank arm** by partially rotating the **cam** clockwise and opening the **breech mechanism lever** to allow sufficient space for the **crank arm** to pass.
- (8) Rotate the **cam** clockwise about 135 deg. from the normal position, swinging the **breech mechanism lever** sufficiently to allow this, and withdraw the **cam**.
201. To replace the alternative gear the operation described should be reversed.

## CAUTION

*On no account should full charges be fired from a mounting on which reduced charge gear is shipped.*



## CHAPTER III

## SECTION 1—THE TRAINING BASE, CENTRE PIVOT AND ROLLERS

## Plate 16

**LOWER RACER BASE PLATE**

222. The **lower racer base plate** (Fig. 1) consists of a steel casting which is bolted to a steel packing ring, and through this to the deck by 28 holding-down bolts of  $1\frac{1}{2}$  in. diameter and 28 cheese-headed screws of  $\frac{3}{8}$  in. diameter. On top of the base plate a circular roller path is formed, which carries the **training rollers**. The **training rack** is bolted to the base plate inside the roller path. A projection on the outside of the lower roller path is machined to provide a facing for the **training clips**. These clips prevent the mounting from lifting when the guns fire.

223. The spaces outside the roller path and between the roller path and the training rack are drained through small holes into a **drain groove** cut on the underside of the base plate and thence to the centre of the mounting through grooves between the packing ring and the base plate (Fig. 3). Water collects in a drain sump under the centre of the mounting, and is drained from here through a pipe to a scupper.

224. A large boss is formed in the centre of the base plate, into which fits the outer race of the **centre pivot roller bearing**.

**TOP RACER CARRIAGE PLATE**

225. The **top racer carriage plate** consists of a steel casting to which the carriage is bolted. The upper roller path is formed on the underside of the carriage plate. Two gaps are cut in the upper roller path to allow the rollers to be removed for examination (Fig. 4).

**CENTRE PIVOT**

226. The centre pivot (Fig. 2) is spigoted into the carriage plate and extends downwards from the centre of the carriage plate through a hole in the base plate. A roller bearing is fitted between the centre pivot and the base plate, and takes the lateral thrust on the mounting when the guns fire. The centre pivot is hollow, and the electric cables and the voicepipe are led up through it to the mounting.

**THE CLIPS**

227. The clips are bolted to the carriage plate and prevent the mounting from lifting when the guns fire by bearing against the underside of the lower roller path. There are three clips—one long clip at the front and two short clips at the rear. The correct clip clearance is  $\cdot 0\cdot 10$  in. Light cover plates between the clips prevent dirt from getting on to the roller path.

**TRAINING ROLLERS**

228. The rollers (Fig. 3 and Fig. 4), of which there are 50, are made of stainless steel. They are slightly tapered externally, and have flanges at both ends. The rollers rotate freely on the axis pins. The axis pins are screwed into the **live roller ring**, and are connected in pairs by **links** which fit over the hexagon heads of the pins and are secured by split pins.

**LUBRICATION**

229. Oil grooves are cut round the roller axis pins for lubrication of the rollers and pins. The oil is fed from two **lubricators** in the carriage plate and passes into a channel cut in the top of the live roller ring. Oil holes are drilled in the live roller ring to feed the oil to each roller.

**STRIPPING****TO REMOVE THE CENTRE PIVOT ROLLERS**

230. Four tapped holes are provided in the top of the centre pivot in which **forcing screws** can be inserted to remove the roller cage for examination.

The four tapped holes are normally plugged with preserving screws. Before forcing down on the roller cage, the **retaining ring** at the underneath side of the roller race must be removed. A hole is cut in the deck, and the central plate of the drain sump under the mounting is portable for the removal of the rollers and cage.

**TO REMOVE A TRAINING ROLLER (FIG. 4)**

231. Two **gaps** are cut in the upper roller path to allow the rollers to be removed for examination. These gaps are situated one on each side of the mounting near to the centre line. Remove the side cover plates over the gaps in the upper roller path. Train the mounting till one of the gaps is over the roller to be removed. Remove the link and unscrew the axis pin from the live roller ring. Then lift up the roller till the flanges clear the lower roller path and withdraw the roller.



### CH. III. SECTION 2—THE CRADLE, RECOIL AND RUN-OUT ARRANGEMENTS

#### Plate 17

238. The cradle consists of a complete steel casting which carries both guns and into which are screwed and shrunk securely into place the two forged steel trunnion pins.

239. Secured to the underside of the cradle by fitted bolts is the **elevating arc** of forged steel.

240. Four bronze rings are riveted into either end of the cradle on which the gun bears during recoil and run-out. Stauffer grease lubricators are fitted to force grease in between these rings and the gun.

241. The **balance ring** carries the **recoil cylinder**, **control rod** and **compensating tank**.

242. The **piston rod** of the recoil cylinder is secured to a lug on the cradle by two nuts.

243. The **recuperator cylinder** is secured to the cradle, and the **recuperator ram** is secured to the balance ring by two **tie rods** and a **crosshead**.

244. The **intensifier** is mounted on the cradle and is arranged with air charging connection and valve, liquid charging adaptor, and boss for pressure gauge.

245. The recoiling portion of the **interceptor** is secured to the balance ring, the non-recoiling portion or falling contact box being fitted to the S.A. crank arm bracket on the cradle.

✓ Page 25: paragraph 246. Add "When balance rings are fitted to guns, care must be taken that the surfaces where the balance ring overlaps the breech ring are well served with thick graphited grease. Otherwise rust will occur and the breech ring may be difficult to remove when the barrel requires exchange."

(G. 06999/43.—A.F.O. P.8/46.)

248. Flats are machined on either side of this cylinder and two bronze bearing plates secured in the balance ring take against these flats.

Thus the balance ring and hence the gun is prevented from turning in the cradle on firing.

249. The recoil piston rod is arranged with a small clearance in the lug on the cradle to which it is secured, so allowing for wear of the bearing rings in the cradle and for the tendency of the gun to twist, without the strain being taken by the sides of the piston rod against the glands of the recoil cylinder.

250. The guns and cradle, with all details, including recoil liquid, etc., in place, are carefully balanced about the trunnions by adjusting lead weights which are carried in pockets in the balance ring.

**Note.**—When balancing, both guns are to be loaded.

#### INTENSIFIER

251. The **intensifier** consists of a cylinder in which travels a piston and **piston rod**.

An indicator at the rear of the intensifier shows whether the intensifier is "Full" or "Empty."

#### ACTION OF INTENSIFIER

252. A pipe transmits the **air pressure from recuperator** to the front of the intensifier, the initial pressure being 970 lbs. per square inch. The rear end of the intensifier cylinder is full of liquid and is connected by a pipe **liquid to recuperator gland** to the inside of the "U" leathers of the recuperator gland.

253. The effective area on the front side of the piston is greater than the other side by the area of the rod, and the liquid is consequently forced into the recuperator gland at a higher pressure than that of the air in the recuperator, thus keeping the "U" leathers tight in the recuperator.

254. As the air pressure in the recuperator rises during the recoil of the gun, so does the intensifier correspondingly increase the pressure of the liquid on the recuperator "U" leathers.

255. The piston is kept tight by "U" leathers and the piston rod by a "U" leather and packing.

#### FILLING THE INTENSIFIER WITH LIQUID

256. Before charging the intensifier with liquid for the first time, or after re-assembly, the indicator should be set at "Empty" to ensure that there is as little air as possible on the liquid side of the intensifier system.

257. Detach plug from charging inlet "B," connect charging pump to charging inlet, open valve "A" and pump until intensifier indicator registers "Full."

258. Close valve "A" and detach pump and replace plug in the charging inlet.

259.—*Composition of Liquid Mixture.*—1 part potash soft soap to 2 parts of heavy torpoyl, about 3/4 pints of mixture is required.



### CHARGING THE RECUPERATOR AND INTENSIFIER WITH AIR

260. The recuperator is charged with air through the intensifier from the ship's H.P. air supply. An instruction plate is fitted to the mounting.

Lay the guns horizontally, and screw the pressure gauge into the connection engraved "G."

Detach the cap nut on the air charging connection engraved "E" and attach the flexible air charging hose.

Open the air charging stop valve engraved "F" and charge with air to a pressure of 970 lbs./sq. in.

Close the valve "F" and detach the flexible hose and the pressure gauge and replace the cap nut on the adaptor "E."

A drain valve is provided at the rear end of the recuperator which may be opened to adjust the air pressure in the recuperator.

The **recuperator drain valve** should be opened periodically to ensure that no intensifier liquid or water is present inside the recuperator cylinder.

### STRIPPING INSTRUCTIONS FOR RECUPERATOR

#### 261. I. TO REPACK RECUPERATOR CYLINDER GLAND

- (1) Put the gun to depression.
- (2) Release the air pressure by opening the drain valve.
- (3) Withdraw the ram securing nut split pin and remove the ram securing nut.
- (4) Remove the stop key, tie rod front securing nuts and split pins, and crosshead. Space is now available to repack the gland in the usual manner.

#### II. TO REMOVE RECUPERATOR RAM AND CYLINDER SEPARATELY

- (1) Proceeding from I, remove the gland packings. Withdraw the recuperator ram forward.
- (2) Remove the pipe adaptors to the cylinder, the cylinder securing nut and locking plate, the cylinder locating screw and the drain valve.
- (3) Withdraw the recuperator cylinder forward out of the balance weight.

#### III. TO REMOVE RECUPERATOR RAM AND CYLINDER TOGETHER

- (1) Proceeding from I, remove the recuperator cylinder as described in II, withdrawing the whole unit forward without unpacking the gland.

### THE RECOIL CYLINDER. (Plate 18)

262. The energy of the recoil of the gun is absorbed mainly by the recoil cylinder and piston but partly also by the compression of the air in the recuperator cylinder.

263. The recoil cylinder is rigidly secured in the underside of the balance ring by a shoulder at the rear end and a nut at the front end, within the cylinder is the hollow piston rod and piston into which is screwed the **recoil control ring**.

264. The front end of the piston rod is secured by nuts to a lug in the cradle. It is not a close fit in the lug and this permits the rod to "drop" the very small amount required to allow for "drop" of the gun, due to wear of the bearing rings in the cradle.

265. Within the hollow piston rod fits the **control rod** which is secured at its rear end by a nut and therefore moves in recoil with the gun.

### ACTION DURING RECOIL

266. When the gun recoils, the cylinder and control rod are carried to the rear with the gun, the piston and piston rod remaining fixed.

267. As the cylinder travels to the rear, the liquid in it is forced through the **ports** in the **piston head**, through the **annular space (C)** between the recoil control ring and the control rod to the rear of the cylinder.

268. This annular space becomes gradually smaller during the recoil because the control rod is tapered, having its maximum diameter at the front end.

269. The shape of the taper is designed so that the retarding effect is approximately uniform throughout the length of recoil.

270. The pressure set up in the cylinder also forces a certain amount of liquid into the space between the piston rod and the control rod.

271. The front end of the control rod is fitted with a **control shuttle valve**, the travel of which is limited by the retaining nut screwed to the control rod.

272. During recoil, the control shuttle valve is forced by pressure of liquid towards the front, thereby allowing liquid to pass through the **ports (A)** into the increasing **space (B)** which at the end of recoil will be completely filled.

### ACTION DURING RUN-OUT

273. On completion of recoil the gun is returned to the firing position by the pressure of air in the recuperator cylinder. The speed of run-out is governed by three **control grooves** which are cut



in the inside wall of the piston rod. These grooves are of varying cross-sectional area and are largest at the rear end, gradually diminishing in depth towards the front.

274. When the run-out commences, the control rod begins to travel to the front. Sufficient pressure is now set up in the space (B) to force the control shuttle valve hard over to the rear, thus completely closing the ports (A).

275. The only passage available for the escape of liquid from the space (B) is over the control

✓ *Note.*—In future when wear is found to have occurred in the bore of the recoil piston rods (Item 1 of drawing N.5173), the worn piston rod is to have the bore ground true and an oversize shuttle valve (Items 6 and 7 of drawing N.5173) fitted. On no account should the bore of the recoil piston rod be increased above 2.560-in. (+.022-in.).

The words "OVERSIZE BORE", followed by the new diameter, are to be stamped on the face of the piston rod.

The final diameter of the shuttle valve is to give a diametric clearance of not less than .002-in., and not more than .005-in. in the new bore. The word "OVERSIZE", followed by the new diameter, is to be stamped around the 2.15-in. diameter portion of the valve. A small brass plate engraved "OVERSIZE SHUTTLE VALVE FITTED" is to be attached to the end of the control rod so as to be visible when recoil cylinder is assembled.

When oversize shuttle valves are fitted, a report is to be forwarded to the Director of Naval Ordnance, Admiralty, Bath, quoting the Register Number of the mounting, whether for right- or left-hand gun, the new diameter of the shuttle valve and the piston rod bore.

Oversize shuttle valves 2.56-in. diameter should be demanded from Naval Ordnance Department ("Q" Section) as required.

Final machining to the required size is to be carried out by the refitting authorities.

One spare shuttle valve, machined to the new diameter, will be supplied for each oversize valve fitted, for retention in ship spares.

The report mentioned in sub-paragraph 4 of this note should include remarks concerning behaviour of the gun concerned during run out and of the action of the S.A. gear.

(Amendment No. 27.)

seatings.

The recoil system should be carefully filled as air trapped in the system will result in excessive recoil and fierce run-out, which may cause damage to the S.A. Gear.

#### TO FILL THE RECOIL CYLINDER

281. An instruction plate is fitted to the mounting.

- (1.) Lay the guns to 45 deg. elevation.
- (2.) See that the drain plug is in place and remove the air escape plugs (m) and (z).
- (3.) Remove the filling and air escape plugs at the top of the compensating tank and pour in the liquid until it runs out of the hole for air escape plug (z).

(7.) To ensure that all air is expelled from the system, the mounting should then be worked from full depression to full elevation several times and, between each operation, should be vented at 45 deg. elevation through plugs (m) and (z). From time to time during this operation, the gun should be hauled back, eased out, and vented in the run out position.

(Amendment No. 28.)

Page 27. After paragraph 281 (9) (as amended by A.F.O. P. 221/42) add note as follows:—

"*Note.*—Oil O.M. 13 **must** be used (instead of glycerine and water) in recoil cylinders which have been fitted with modified control rings in accordance with Modification No. 85."

(G. 04086/50.—A.F.O. P. 9/51.)

are arranged for the pressure to expand the "U" leather during recoil.

283. The rear end of the cylinder is closed by the seating arranged on the collar of the control rod which is forced home on to a copper joint ring by means of the retaining nut which screws into the cylinder.

The section of the copper ring is such that it is expanded readily by the pressure of the nut, thereby ensuring an effective seal.

284. A stop key is fitted in the cradle just clear of the run-out crosshead when the gun is in the fully run-out position, its object is to allow the recoil cylinder gland to be re-packed without releasing the pressure in the recuperator cylinder. This can be done by unscrewing the nut securing the recoil piston rod to the lug on the cradle, then easing back the long nuts on the rear ends of the crosshead tie rods and slightly elevating the gun.

285. The gun will run back under its own weight, the recuperator ram being retained in position by the stop key.

The tie rods are long enough to allow the gun to be run back as far as is necessary for the glands at the front end of the recoil cylinder to be re-packed. The long nuts on the tie rods can be turned back fifty-four turns with safety.



286. After re-packing, the gun must be run-out by means of the long nuts on the tie rods. It is essential that the long nuts be screwed hard up to ensure the plan clearance between the crosshead and the stop key.

### **RUN-OUT ARRANGEMENT**

287. The gun is run-out by compressed air, and the arrangement of the recuperator is shown on plate .

The recuperator cylinder above the gun is rigidly secured to the cradle and does not move as the gun recoils or runs out.

Within the cylinder works a hollow ram which is secured by a nut to the crosshead.

Two tie rods connect the crosshead to the balance ring on the gun and thus the movement of the gun during recoil is imparted to the hollow ram.

A machined surface is provided on top of the cradle to act as a guide for the crosshead.

The recuperator cylinder is connected by a pipe to the intensifier. (Plate 17.)

The cylinder can be charged through a flexible hose fitted to a connection arranged on the front of the intensifier.

The recuperator cylinder should be charged to 970 lbs. per square inch.

### **ACTION OF RUN-OUT CYLINDER**

288. When the gun recoils, the ram is carried to the rear into the recuperator cylinder, further compressing the air therein. This increase of pressure assists the recoil system to bring the gun to rest.

When the recoil of the gun is overcome the pressure in the recuperator cylinder asserts itself and forces the ram to the front, so returning the gun to the firing position.

The gland of the recuperator cylinder is formed by two "U" leathers between which liquid is forced, at a greater pressure than the air inside the cylinder, by the intensifier which is connected direct to the liquid gland at the front end of the cylinder.

Outside the "U" leather gland is another gland of cotton packing.

## **STRIPPING**

### **289.—I. TO REPACK RECOIL PISTON GLAND**

- (1) Drain the recoil cylinder by opening the drain valve.
- (2) Remove the piston rod split pin and nut.
- (3) Ease back the long nuts on the rear ends of the recuperator tie rods, and slightly elevate the gun. The gun will run back under its own weight, withdrawing the piston rod end out of the lug on the cradle.
- (4) Remove the piston rod collar locking screw, and piston rod collar.
- (5) Space is now available for repacking the piston gland in the usual manner.

### **II. TO REMOVE THE CONTROL ROD AND RECOIL PISTON COMPLETE**

- (1) Remove the breech mechanism to obtain access to the control rod retaining nut, then proceeding from (I), remove the gland packings.
- (2) Remove the retaining nut for the control rod.
- (3) Withdraw the control rod and recoil piston to the bench.

### **III. TO REMOVE THE CONTROL ROD AND SHUTTLE VALVE**

- (1) Withdraw the control rod out of the piston rod, to allow of access to the recoil control ring.
- (2) Remove the recoil control ring locking plate by withdrawing the split pin and securing nut. Withdraw the control rod together with the control ring for examination of the shuttle valve.

### **IV. TO REMOVE THE RECOIL CYLINDER COMPLETE**

- (1) Remove drain plug and drain the recoil cylinder.
- (2) Remove the filling adaptor in bottom of recoil cylinder at rear, piston rod nut, air valve "Z," cylinder securing nut locking bolt, and cylinder securing nut.
- (3) Withdraw cylinder complete from balance ring.



## CH. III. SECTION 3—THE TRUNNIONS

## Plate 19

296. The **trunnion brackets** are made of cast nickel steel accurately fitted and keyed to the facing plates provided on the top of the carriage side plates.

A phosphor-bronze **spherical bearing** in halves is assembled on the **trunnion pin** and is maintained in position by the **trunnion keep**. A dowel pin secured in the trunnion keep prevents the spherical bearing revolving.

In order to reduce elevating efforts a ball thrust bearing is interposed between the inner face of the spherical bearing and the collar of the trunnion pin, and a self-aligning roller journal bearing is fitted on the end of the trunnion pin.

The roller bearing is carried on an anti-friction device, comprising a support for the bearing arranged with an adjusting washer and a pair of **Belleville washers**.

The load on the Belleville washers is regulated by means of a differential screw arrangement consisting of an **adjusting screw** and **adjusting screw bush**.

To apply the load, one full turn down of the bush raises the screw .0167-in. so that a very fine adjustment can be obtained.

The correct position of the bush is determined by a groove in the collar which must coincide with either the assembly or adjusted positions marked on the indicator plate screwed to the trunnion bracket. The adjusting screw is finally secured in position by means of a **locking bolt**, the end of which engages in a slot formed in the collar of the screw.

When the adjusting screw is raised to the adjusted position, the weight of the elevating mass is transferred from the spherical bearing to the roller bearing, and the elevating effort at the handwheel is a minimum.

On firing, the Belleville washers yield, and the firing shock is transmitted through the spherical bearing to the carriage.

A **locking plate** is provided to secure the adjusting bush when in the adjusted position. Covers are fitted on the outside of the trunnion bracket to protect both the roller journal bearing and the details of the anti-friction gear.

An **elevation indicator** is fitted to the end of the trunnion pin on the left-hand side only, and can be illuminated by means of the electric **lamp** provided.

297. *Note*.—Experience in service has shown that the design of the carriage permitted, in course of time, a spread of the carriage sides away from the centre of the mounting resulting in lateral movement of the cradle.

The earlier deliveries are therefore being modified by, and later deliveries provided with, an additional thrust bearing at each side whose effect is to tie the carriage sides together, through the medium of the cradle and trunnion pins.

## ADJUSTMENT OF LOAD ON BELLEVILLE WASHERS

298. The following method should be adopted for assembling and adjusting the Belleville Washers and adjusting screw assemblies :—

- (a) Screw the **adjusting screw** into the **adjusting screw bush** until there is .05-in. clearance between the under side of the collar of the former and the top of the latter.
- (b) Screw these assembled items into the trunnion bracket until the groove on the collar of the **adjusting screw bush** coincides with the "ASSEMBLY" index line on the **indicator plate** R.H. or L.H.
- (c) Lock the **adjusting screw** with the **locking bolt**.

Page 29 (as inserted by A.F.O. P.526/51), ~~was amended~~ with the Belleville washers and adjusting washer, 298A. Due to wear hammering and other causes the method of adjustment described above does not give the same clearance between trunnion and trunnion brass in all instances. Neither does it always result in the correct clearance being set.

298A. Due to wear hammering and other causes the method of adjustment described above does not give the same clearance between trunnion and trunnion brass in all instances. Neither does it always result in the correct clearance being set.

To obtain the correct clearances, the adjusting screw bush should be screwed in the direction of the arrow until the hand elevating efforts drop to a suitable near minimum value.

A check may be made by means of a clock gauge, secured to one of the cap square bolts, to observe the actual movement of the trunnion pin which should be approximately 0.002-in.

(G. 1220/53.—Amendment No. 25.)

## INSTRUCTION FOR REPAIR OF CORRODED TRUNNION PINS

299. The trunnion pins should be machined to clean up the pits for a distance along the pins of 3-in. and new brasses made and fitted to suit the new diameter. The minimum diameter to which a pin may be reduced before renewal is necessary is 4.5-in. Both pins should be machined to the same diameter. The amount of metal removed should be the minimum required to clean up the pin.

The new diameter should be clearly stamped on the brasses and in a convenient position on the trunnion pin.



It should be noted that the plain bearing portion of the trunnion pins are required to take the firing load only and a roughened surface for this work does not affect the efficiency of the mounting. If the roughened surface is increasing the elevating efforts the adjustment of the roller bearing should be examined.

In view of the above remarks and the work involved in machining the trunnion pins and making new brasses, the above method of repair should not be undertaken unless the corrosion has assumed serious proportions.

No hard and fast rule can be laid down as to when, or when not, to repair trunnion pins as above, the decision must lie with the Repair Authorities at the refitting port treating each mounting on its merits.

When a mounting is repaired by this method the Register No. should be reported to the Admiralty, together with the *new* diameter of the trunnion pins.

300.

#### CH. III. SECTION 4.—THE HAULING BACK GEAR.

##### Plate 20

301. No deck fittings are required for this type of hauling-back gear and slip tests should be carried out with the guns near the horizontal position. The assembled gear is tested to 12 tons.

302. The front end of the gear is secured to the gun by a *muzzle cap* which is made in halves. The **rear links** are fitted over the retaining collars of the pin in the cradle and connected to the muzzle cap rod by the bottle screw and slip hook.

For guns with parallel muzzles an adaptor bush must be used, or the muzzle cap must be securely lashed to the gun muzzle to prevent the muzzle cap from flying off when the gun starts to buffer during run out.

303. The following precautions are always to be taken before a Slip Test is carried out :—

- (a) At R.P.C. mountings all clutches are to be in "hand" and the mounting moved by hand only.
- (b) A hard wood chock of sufficient height to leave the guns approximately horizontal is to be provided between the baseplate and the balance weight of the gun which is **not** being tested. Care is to be taken to avoid damage to the pipe connection to the compensating tank situated below the balance weight.
- (c) The guns are to be elevated to ensure the chock is gripped and the handles are to be **securely lashed** in that position.
- (d) Should it ever be necessary to slip test both guns in a mounting at the same time, subject to two sets of hauling back gear being available, a stop piece is to be inserted in the teeth of the elevating arc in such a position that with the guns approximately horizontal, the projectors of the stop piece each side will bear on the elevation buffer rods situated each side of the elevating pinion bracket. The stop piece is to be held in position by a strap around the T section of the arc and secured to the stop piece by suitable bolts. Flat bar or angle bar cut away in wake of the arc teeth should be used for the stop piece.

*Note.*—When slip testing one gun only, the precautions outlined in (d) above may be used in addition to those prescribed in (a), (b) and (c) if desired and are advisable if there is motion on the ship.

304. No one is ever to go or work beneath the cradle during the Slip Test operation.

#### TO SLIP TEST THE GUN

305. Before using the gear to haul back, adjust the support rope to take the weight of the gear as shown on the plate. Set the levers of the semi-automatic gear and the breech mechanism to "semi-automatic". Haul the gun back by operating the ratchet lever.

306. Before slipping the gun by releasing the slip hook, the portable handle should be removed and the sight cross shaft protected by a shotmat or by lashing the rear links to the gun.

307. The ratchet is double-acting and can be reversed to run-out the gun in slow action if required.

308-310.

(G. 07462/51.—A.F.O. P.526/51.)



## CH. III. SECTION 3—THE TRUNNIONS

## Plate 19

296. The **trunnion brackets** are made of cast nickel steel accurately fitted and keyed to the facing plates provided on the top of the carriage side plates.

A phosphor-bronze **spherical bearing** in halves is assembled on the **trunnion pin** and is maintained in position by the **trunnion keep**. A dowel pin secured in the trunnion keep prevents the spherical bearing revolving.

In order to reduce elevating efforts a ball **thrust bearing** is interposed between the inner face of the spherical bearing and the collar of the trunnion pin, and a self-aligning **roller journal bearing** is fitted on the end of the trunnion pin.

**"ADJUSTMENT OF LOAD ON BELLEVILLE WASHERS"**

298. The following method should be adopted for assembling and adjusting the Belleville Washers and adjusting screw assemblies.

- (I) Screw the **adjusting screw** into the **adjusting screw bush** until there is .05-in. clearance between the under side of the collar of the former and the top of the latter.
  - (II) Screw these assembled items into the trunnion bracket until the groove on the collar of the **adjusting screw bush** coincides with the 'ASSEMBLY' index line on the **indicator plate** R.H. or L.H.
  - (III) Lock the **adjusting screw** with the **locking bolt**.
  - (IV) Assemble the support for the **roller journal**, with the Belleville washers and adjusting washer, on the trunnion bracket.
  - (V) Screw the adjusting screw bush in the direction of arrows until the groove on its collar coincides with the line marked 'ADJUSTED POSITION' on the indicator plate, which will then ensure a maximum working load of 3 tons on the Belleville Washers.
- (The stripping instructions are indicated on Plate 19.)

**IMPORTANT**

When Belleville Washers are replaced, complete 'mated' sets of Belleville washers and associated washer should be used, as supplied in the 'C' set of spares."

(G. 4422/47.—A.F.O. P.388/47.)

302. No dock fittings are required for this type of hauling-back gear and should be carried out with the guns near the horizontal position. The assembled gear should be tested to 12 tons.

303. The front end of the gear is secured to the gun by a muzzle cap which is fitted in halves. The rear links are fitted over the top of the gun and connected to the muzzle cap rod by the bottle screw and slip hook.

(a) At R.P.C. mountings all clutches are to be in 'hand' and the mounting moved by hand only.

(b) A hard wood chock of sufficient height to leave the guns approximately horizontal is to be provided between the baseplate and the balance weight of the gun which is not being tested. Care is to be taken to avoid damage to the pipe connection to the compensating tank situated below the balance weight.

(c) The guns are to be elevated to ensure the chock is gripped and the handles are to be **securely lashed** in that position.

(d) Should it ever be necessary to slip test both guns in a mounting at the same time, subject to two sets of Hauling back gear being available.

304. Add to paragraph 302 (as amended by A.F.O. P.415/44) :—

For guns with parallel muzzles an adaptor bush must be used, or the muzzle cap must be **securely lashed** to the gun muzzle to prevent the muzzle cap from flying off when the gun starts to **run out**.

the stop piece by suitable bolts. Flat bar or Angle bar cut away in wake of the stop teeth should be used for the stop piece.

When slip testing one gun only, the precautions outlined in (d) above should be used in addition to those prescribed in (a), (b) and (c) if desired and are feasible if there is motion on the ship.

No one is ever to go or work beneath the cradle during the Slip Test.

305. To test the gun

Before using the gear to haul back, adjust the support rope to take the weight of the gear as shown on the plate. Set the levers of the semi-automatic gear to "semi-automatic". Haul the gun back by operating the ratchet lever.

Before slipping the gun by releasing the slip hook, the portable handle should be removed and the sight cross shaft protected by a shotmat or by lashing the handle to the gun.

The ratchet is double-acting and can be reversed to run-out the gun in slow action if required.

308-310."

(G. 2525/44.—A.F.O. P.415/44.)

of the carriage permitted, in course of the mounting resulting in lateral

ter deliveries provided with, an age sides together, through the are not shown in the plate shown on Plate 19A

**BACK GEAR**

back gear and slip tests should be

, adjust the support rope to take the semi-automatic gear and the operating the ratchet lever.

portable handle should be removed ear links to the gun.

the gun in slow action if required.

P156/44



## CHAPTER IV

### SECTION 1—ELEVATING GEAR

#### Plate 21

311. The elevating gear is operated from the left-hand side of the mounting by means of two handles attached to crank arms which are carried by a **support bracket** fixed to the carriage.

312. A ball race is fitted in a cap at the top of the support bracket and forms the bearing for the crank arm shaft.

313. The drive from the handles turns a bevel wheel and bevel pinion, the latter being keyed to the worm shaft and thence through the worm and wormwheel which actuates the elevating pinion shaft and **elevating pinion**.

314. The layer is provided with an adjustable **seat** and adjustable **foot rest** secured to the **platform**.

315. The **elevating receiver** is situated in front and slightly towards his left.

The forward or clockwise movement of the handles elevates the guns, one complete turn of the handles elevates the guns through 3 deg.

316-320.

#### **ELEVATING GEAR—ARRANGEMENT OF WORM DRIVE AND PINION. (Plate 22)**

321. The elevating **pinion** is arranged on the fore and aft centre line of the carriage and is driven by a worm **shaft** through a **worm, wormwheel** and **friction discs**.

322. The worm shaft is operated by the elevating handles through a pair of **bevel wheels**, from the left-hand side of the carriage.

323. The pinion is supported by a bracket which is fitted and keyed to the facing on the elevating structure between the carriage sides.

324. The pinion shaft is provided with roller bearings arranged in the pinion bracket and a ball bearing in the wormwheel bracket.

325. The wormwheel bracket is spigoted into an inner facing and the side plate of the carriage and is secured by bolts.

326. In order to ensure that the wormwheel bracket is a good fit between the inner facing on the carriage and the facing on the elevating box girder structure, a **tapered piece** is fitted between the latter facing and the base of the bracket.

327. The cover for the wormwheel bracket is spigoted into an outer facing and the carriage side plate.

328. The worm runs in an oil bath and an oil level plug and drain plug are provided in the cover.

329. A double thrust bearing is fitted on the worm shaft to take the axial thrust in either direction and ball bearings are fitted to support the worm.

330. Instructions for assembling the Belleville washers are given on the plate.

#### **STRIPPING**

331. **REMOVAL OF WORM.**—(1) Drain the elevating wormwheel bracket of oil and remove its cover.

(2) Remove the bevel gear box cap.

(3) Remove the wormshaft split pin, securing nut and pinion.

(4) Remove the bevel gear box and bearing.

(5) Remove the nut and check nut securing the thrust bearing, and remove the thrust bearing from the shaft.

(6) Remove the end cover for the wormwheel bracket.

(7) Withdraw the wormshaft and remove the worm and worm bearings.

332. **REMOVAL OF ELEVATING SHAFT AND PINION**, after the removal of the worm.—(1) Remove the pinion shaft inner bearing, securing cap, locking plate, and cap.

(2) Remove the inner bearing shaft nut and check nut, after taking the necessary precaution to prevent the elevating pinion being rotated while these nuts are slackened back.

(3) Remove the pinion shaft outer bearing, securing nuts, and locking plates, and slack back nuts on shaft.

(4) Similarly remove the locking plates and securing nuts in the way of the bearing in the elevating wormwheel bracket. Withdraw the elevating pinion shaft, complete with wormwheel, Belleville and friction washers, etc.

(5) Remove the elevating pinion and elevating pinion shaft bearings.



### LUBRICATION

333. The wormwheel is lubricated by means of a Rotherham's lubricator fitted in the top of the wormwheel bracket while lubrication is provided to all ball and roller races by Enot's lubricators.

### GUN-LAYER'S FIRING GEAR

#### Plate 23

334. The drive from the **handles** is through a **bevel wheel** and **bevel wheel pinion** to the elevating worm shaft.

335. The **trigger** is connected by a pair of **links** to a slip ring (arranged in the **firing handle**) which engages with the **actuating firing lever**.

336. This lever operates the **firing switch** by means of a **push rod** passing through the centre of the **bevel wheelshaft**. The firing gear is brought back to the normal position by the action of the **return spring**.

337. The end of the actuating firing lever is fitted with an **adjustable taper** to regulate the movement of the push rod.

338. The guns can be fired by the trigger through either the main or auxiliary firing circuits.

### LUBRICATION

339. Lubrication is provided to all ball races by Enot's lubricators, three Springwell oil cups are also fitted and an oil hole arranged in the firing handle.

### STRIPPING

340.—(1) Remove the split pin securing the inner crank handle lever through the bevel wheel driving shaft. Disconnect the support bracket cap, together with the shaft, crank handles and trigger firing gear complete.

(2) Remove the firing switch box.

(3) Remove the outer bevel gear box cover, together with driving shaft, bevel wheel, bearings, etc., complete.

341-345.

## CH. IV. SECTION 2—SAFETY FIRING GEAR

#### Plate 24

346. The gear is designed to ensure that the **interceptors** are broken or cannot be made between the limits of 20 deg. elevation and 10 deg. depression when the mounting is trained into a danger zone. This gear is operated by a vertical **cam rail** secured to the deck.

347. The gear is in two portions, the lower arranged on the right-hand side of the mounting and the upper attached to the cradle.

348. In the lower portion a **spring box** is secured to the channel beam which supports the platforms. This channel beam is fitted at the front of the mounting. A **sliding rod**, operating through the spring box, carries the **cam roller** which moves around the vertical cam rail when the mounting trains. The compression spring in the box maintains the roller on the cam rail.

349. The vertical movement of the sliding rod is transferred through a series of levers to a **sliding cam** fitted in a guide bracket attached to the inside of the right-hand trunnion bracket.

350. The upper portion of the gear is supported on the cradle by small brackets.

351. The bracket supporting the **bell crank lever** carrying the roller which is actuated by the sliding cam is fitted on the right-hand side of the cradle only.

352. Another bell crank lever, supported by the same bracket, imparts the travel to the rods which break the interceptors on the right and left-hand sides of the cradle.

353. An adjustable spring is provided for returning the gear on the cradle when a safe area is reached; this spring is arranged in a **spring box** on the right-hand side only.

354. The spring is to be adjusted so that the compression of the spring is just sufficient to return the gear on the cradle.

### ADJUSTMENT OF SAFETY FIRING GEAR

355. The lower portion of the safety firing gear—that is, the system of levers operated by the deck cam and controlling the sliding cam—are not adjustable. The movement of the levers is controlled by the contour of the deck cam.

The maximum travel of the various levers necessary to operate the safety firing gear at its limit of 20 deg. elevation of the mounting is shown on the Plate.

356. The upper portion of the safety firing gear secured to the cradle is provided with adjusting nuts to obtain the exact travel required. These nuts should be adjusted so that the upper roller is



moved 0.6-in. by the movement of the sliding cam. With the same adjustment the collars of the horizontal rods should be in contact with the stop faces on the brackets when the roller and sliding cam are disengaged.

357. In the "safe" position the horizontal push rods operating the interceptors should be 2.9-in. from the beating face of the balance ring. When the mounting enters a danger area the horizontal push rods will move 0.4-in. The clearance between the end of the push rod and the interceptor in the "safe" position is .05-in. When these adjustments have been made, it should be checked that interceptors open some 2-3° before the danger angle.

357 (1). **Warning.**—Failure of the safety firing gear to operate correctly may be due to:—

(a) Lack of adjustment—this is inexcusable.

(b) Lack of maintenance—this is also inexcusable; very thorough lubrication and maintenance is necessary.

*Note.*—Examination of the safety firing gear to ensure that the interceptors cannot be made in the danger angles should be carried out half-yearly.

### THE SAFETY FIRING SWITCH AND OPERATING GEAR.

#### Plate 24A.

#### Introduction

357 (2). The original safety firing gear prevented firing in the danger zone when the guns were at any angle between 10° depression and 20° elevation. At angles of elevation above 20° the gear was ineffective. The safety firing switch and its operating gear has been designed to prevent firing up to any desired angle, between 10° depression and 80° elevation, when the guns are on a dangerous bearing. The principal difference between these two types of safety firing gear is as follows:—

With the original type, the firing circuits were broken on reaching the danger zone, by the automatic opening of the interceptors, which were mechanically operated through a system of rods and levers carried on the mounting, by means of a vertical cam rail fixed to the deck.

The firing switch, however, breaks the firing circuits for both guns and is in addition to, and independent of, the interceptors.

357 (3). The safety firing switch is operated by a floating lever, the movement of which is controlled by two separate systems of linkage. One end of the floating lever is connected to the right trunnion pin, whilst the other end is connected to a vertical spring loaded plunger situated between the platforms at the front of the mounting. The lower end of this plunger is connected to a roller arm, carrying a cam roller, which comes into contact with a fixed vertical cam rail whenever the mounting trains on to a dangerous bearing.

The profile and extent of the cam rail is obviously dependent upon the position occupied by the mounting on the ship in relation to the various obstructions, and is designed on installation to permit the maximum field of fire commensurate with safety and blast restrictions.

357 (4). The plate shows an isometric arrangement of the operating gear with the safety firing switch in position, an inset of a section through the switch and a further inset of a section through the guide bracket and the spring loaded plunger.

An indicator showing whether the contacts are "made" or "broken" is fitted close to the breech worker of the right gun. The indicator is operated from one of the trunnions pins of the safety firing switch.

#### DETAILED DESCRIPTION

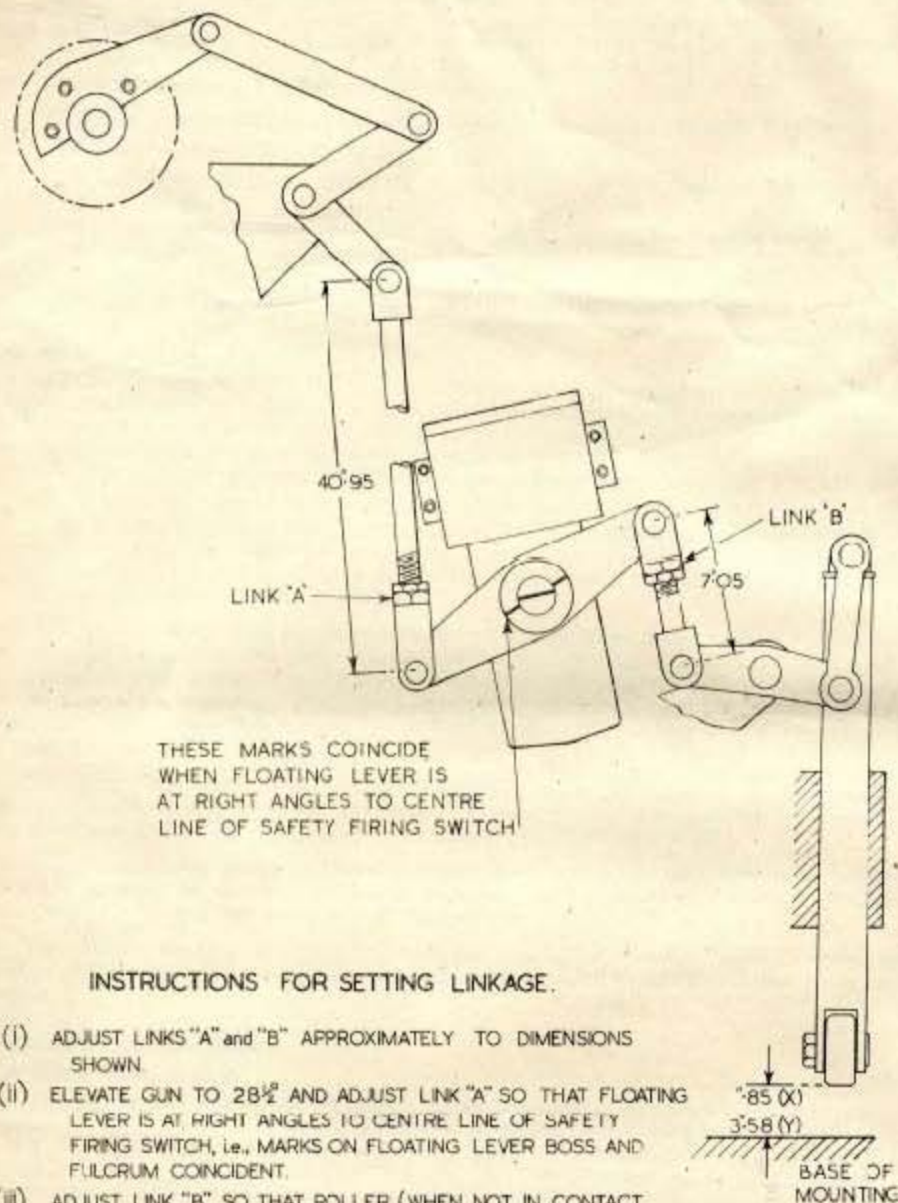
##### The Safety Firing Switch

357 (5). The switch consists of a bracket, to the lower end of which is fixed a guide tube. A sleeve, closed at one end, slides on the guide tube and is prevented from turning by a key which engages with a slot in the guide tube. The closed end of the sleeve is bored to receive the lower end of a plunger which is secured to the sleeve by a nut and split pin. A feather locates the plunger in the sleeve but the recess for the feather permits the plunger to be rotated through 40° for cleaning the contact segments, when required. The sleeve and plunger, therefore, move as one unit. The upper end of the plunger is in the form of a piston with an "oilite" bush which is a sliding fit inside the guide tube. Two trunnion pins are fixed, one on either side of the sleeve, and the floating lever, which is made in halves in the form of a bridle, is bolted together so that the sleeve is between the two portions, and the complete floating lever pivots about its middle point on the trunnion pins on the sleeve. An apron on the bracket covers the upper part of the sleeve when at or near the top of its travel, and so forms a weather shield. The ends of the floating lever are connected to the linkage systems as shown in the arrangement.

357 (6). The bracket forms a chamber at the upper end of the guide tube within which are carried the four terminals. The terminals are arranged in two pairs, one terminal of each pair being connected to the firing circuit C.O.S. and the other terminals are connected, one to the right and one to the left interceptor.

The top face of the piston on the upper end of the plunger carries two contact segments insulated from each other and from the plunger. When the plunger and sleeve are at the top of their travel, the contact segments connect the two terminals of each pair and the firing circuits to both guns are then complete.





#### INSTRUCTIONS FOR SETTING LINKAGE.

- (i) ADJUST LINKS "A" and "B" APPROXIMATELY TO DIMENSIONS SHOWN.
- (ii) ELEVATE GUN TO  $28\frac{1}{2}^\circ$  AND ADJUST LINK "A" SO THAT FLOATING LEVER IS AT RIGHT ANGLES TO CENTRE LINE OF SAFETY FIRING SWITCH, i.e., MARKS ON FLOATING LEVER BOSS AND FULCRUM COINCIDENT.
- (iii) ADJUST LINK "B" SO THAT ROLLER (WHEN NOT IN CONTACT WITH CAM RAIL) IS APPROXIMATELY 3.58 INS. ABOVE BASE OF MOUNTING. (DIMENSION "Y").
- (iv) DEPRESS GUN TO  $10^\circ$  DEPRESSION AND ADJUST LINK "A" SO THAT ROLLER (WHEN NOT IN CONTACT WITH CAM RAIL) IS .85-INS. ABOVE BASE OF MOUNTING. (DIMENSION "X").

#### ADJUSTMENT OF THE SAFETY FIRING GEAR.

See also Plate 24 A



An anti-backlash spring is incorporated in the lower end of the guide tube to ensure that the contacts will break in the event of a pin shearing, or any other part of the gear becoming unconstrained through damage.

#### The Spring-Loaded Plunger

357 (7). The cam roller is carried in one end of the roller arm. The other end of this arm is supported by a pivot fixed to the mounting. The spring-loaded plunger is connected to the roller arm by a link. This arrangement is necessary to relieve the plunger of the side thrusts which it would otherwise have to withstand whenever the roller struck the inclined face of the cam rail.

The guide bracket which carries the spring-loaded plunger is fixed to the mounting. Within the guide bracket are the two springs which tend to keep the roller in contact with the cam rail. When the roller is not on the cam rail, the springs force the plunger down until the weather protection cover comes into contact with the top of the spring retaining cap.

#### Operation.

357 (8). The gear is as shown when the guns are at maximum depression and the mounting is trained on a safe bearing, and is adjusted in this position so that the circuits through the switch are "made". This adjustment is made at the adjustable double eye at the lower end of the long rod in the elevation system.

If the guns are elevated while the mounting remains on this bearing, the left-hand end of the floating lever is raised and the floating lever pivots about its centre, causing its right-hand end to depress, thereby raising the spring-loaded plunger, compressing the springs and so constraining the floating lever to keep the circuits "made". Alternatively, if the guns remain at maximum depression and the mounting be trained on to a dangerous bearing, the cam roller will climb on to the first step of the cam rail. As the cam roller climbs the slope of the first step, the spring-loaded plunger is raised and this motion causes the right-hand end of the floating lever to move downwards, pivoting about its left-hand end which is now the fulcrum.

357 (9). This breaks the circuits through the switch and, if the mounting be stopped training while the roller is on the first step, the circuits will remain broken until the guns are elevated sufficiently to raise the left-hand end of the floating lever (pivoting about its right-hand end) to the point where the circuits are once again "made".

The angle of elevation at which the circuits may safely be "re-made", while the roller is on the first step is, of course, dependent upon the local conditions and, in turn, this angle determines the height of the first step of the cam rail. The circumferential length of the first step is also governed by local conditions. Further elevation of the guns, whilst within the bearing controlled by the first step merely raises the roller from the rail, the circuits remaining "made". When the roller is returned to the rail by depressing the guns, the right-hand end of the floating lever becomes the fulcrum and any further depression breaks the circuits.

357 (10). If the mounting be trained further, the roller may ride over other steps whose height will be governed by the extent of the local conditions which demand such other steps. The operation of the gear will remain the same as has just been described but the guns must be elevated to a greater or lesser angle before the circuits are "made".

#### STRIPPING INSTRUCTIONS.

357 (11). The gear is readily accessible and only two components, the safety firing switch and the spring loaded plunger, require any remarks on stripping.

#### The Safety Firing Switch.

357 (12). A cover on the top of the upper chamber gives access to the terminals for examining the cables and connections. On the front of the upper chamber an inspection door is provided through which it is possible to see the contact segments on the top of the plunger and the lower ends of the terminals.

If the switch requires an overhaul it should be removed to the bench for stripping down.

#### TO REMOVE THE SWITCH.

- 357 (13).—(a) Remove the top cover and disconnect the cables.
- (b) Remove the pins connecting the end of the floating lever with the linkage systems.
- (c) Disconnect the rod to the indicator quadrant.
- (d) Remove the four bolts securing the bracket to the carriage plate.

#### TO REMOVE THE PLUNGER

(After the complete switch has been removed from the mounting.)

- 357 (14).—(a) Remove the indicator operating gear.
- (b) Remove the bolts joining the two parts of the floating lever and take each half off the trunnion pins.
- (c) Remove the nut on the end of the plunger rod.
- (d) Remove the sleeve.
- (e) Remove the locking screw securing the anti-backlash spring housing.
- (f) Unscrew the anti-backlash spring housing and remove it from the guide tube.
- (g) Withdraw the plunger.



## TO REMOVE THE CONTACT SEGMENTS.

(After the removal of the plunger.)

357 (15).—(a) Remove the split pin from the plunger rod just below the piston portion.

(b) Unscrew the centre screw visible on the upper face of the piston. The various portions of the contact segments can then be removed.

**The Spring-Loaded Plunger.**

## TO REMOVE A SPRING.

357 (16).—(a) Remove the nut from the top of the plunger.

(b) Lift off the crosshead.

(c) Remove the locking bolt from the guide bracket.

(d) Unscrew and remove the spring retaining cap.

The upper spring can then be removed and, by lifting the plunger, the distance piece and the lower spring can be removed.

## TO REMOVE THE GUDGEON PIN. (After the removal of the springs.)

357 (17). After the removal of the springs, it may be possible to ease the liner up clear of the gudgeon pin and push it out of the plunger, but if the liner is stiff the plunger will have to be withdrawn from the guide bracket.

## TO REMOVE THE PLUNGER.

(After the removal of the springs.)

357 (18). Remove the pin from the lower end of the link and withdraw the plunger.

**INTERCEPTORS, MARKS 4 and 6****Plates 25 and 25A****Interceptor, Mark 4.**

358. One interceptor is fitted at each gun and carries contacts for the firing and gun ready lamp circuits which can be made only when the mounting is trained on to a safe bearing.

359. The **upper contacts box** is secured to the balance ring and, therefore, recoils with the gun. It accommodates the **actuating lever, actuating and catch bars, toggle lever and change over rod**. The latter is pushed horizontally when changing from main to auxiliary circuit and is locked in position by means of a **spring catch**.360. The **lower contacts box** is pivoted on a bracket secured to a non-recoiling part of the mounting and carries a **hand grip and palm lever** for closing the interceptor. It is retained in its closed position by a spring loaded **catch bolt** which is supported by the catch bar of the upper contacts box. The interceptor can be opened by pulling the catch bolt outwards and allowing the lower contacts box to fall.

361. Unreliable operation of the safety firing gear may be due to wear of the stop piece on the falling contacts box: it is essential that this stop piece should be of steel. Earlier interceptors were made with this stop piece as part of the gun metal casting; interceptors should therefore be examined to see if they have been modified and, if not, Modification No. 23 is to be carried out immediately.

362. **Warning.**—*No attempt must be made to close the interceptor if the danger position indicator shows red.* This indicator is provided to show when the safety firing gear has operated, but it may be possible, due to backlash or bad adjustment, to close the interceptor sufficiently to complete the firing circuit even though it will not remain closed; **the warning given by the indicator must therefore never be neglected.****OPERATION OF THE INTERCEPTOR.**363. As the mounting approaches a danger zone, the push rod of the safety firing gear operates the actuating lever which moves the spring loaded catch bar to the rear. At the same time the actuating bar is moved in the opposite direction by the action of the toggle lever and exposes a red **danger indicator**.364. In moving to the rear, the catch bar releases the catch bolt supporting the lower contacts box and the firing and gun ready lamp circuits are broken as the lower contacts box falls under pressure from a **spring plunger**.365. Further movement of the actuating bar prevents the interceptor from being closed, while the mounting is in the danger zone, by the **toe** on the actuating bar projecting over the **stop piece** of the lower contacts box.

366. When the mounting is trained into a safe zone, the sliding bars are returned to their normal position by the return spring and the interceptor can be closed by hand.

367. It should be noted that the interceptor is opened in a similar manner when the guns recoil by the catch bar releasing the catch bolt and allowing the lower contacts box to fall.

**INTERCEPTOR FOR MOUNTINGS FITTED WITH SAFETY FIRING SWITCH.**

368. On some mountings fitted with safety firing switch the Mark 4 interceptor is used, but it is modified by the omission of the parts operating the original safety firing gear. For later mountings and future manufacture the interceptor, Mark 6, as shown on Plate 25A, is fitted.



**Interceptor, Mark 6.**

369. The Mark 6 interceptor consists of an upper and lower contact box with single firing contacts and two gun ready lamp contacts, but does not contain the catch bar and actuating bar mechanism or the "Main" AUXILIARY change over rod of the Mark 4. The catch bolt of the lower contact box latches on a catch bracket.

This type of interceptor can be made at any time when the gun is fully run out.

370.

**CHAPTER IV—SECTION 3. ELEVATION RECEIVER—MECHANICAL POINTER DRIVE****Plate 26.**

371. The **elevation receiver** is provided with a mechanically operated "follower" pointer which is driven through a split pinion (spring loaded to reduce backlash), shafting and bevel gearing (blue) from the sight arc (purple). The shaft can be readily removed by withdrawing the split pins from the muff couplings at either end and sliding them inwards.

The receiver has a jaw coupling which engages with a corresponding member on the driving shaft; this allows for easy removal of receiver.

372. A **vernier adjustment** is inserted in the drive, just below the elevation receiver to facilitate lining up the pointer.

An adapter is provided where certain types of receivers are fitted and the drive is extended through a pair of bevel gears to the coupling at the rear of the receiver, as shown on the plate.

**ADJUSTMENTS.**

373. To line up the pointer :—

- (a) Slacken back the vernier adjustment coupling nut and slide the clutch sleeve back, releasing the clutch plate.
- (b) Line up the pointer by rotating the jaw coupling until the correct setting is obtained.
- (c) Rotate the clutch plate until a position is found where the serrations on each side coincide with the serrations on the clutch sleeve and dog clutch.
- (d) Slide the clutch sleeve forward and replace the coupling nut finally locking the grub screws.

**LUBRICATION.**

374. Oilers provide lubrication to the gear wheels, and grease nipples are fitted in positions indicated on the plate.

~~475-480.~~

(G. 07778/48.—A.F.O. P.71/50.)

Page 32C. (Inserted by A.F.O. P.71/50).

Last line. Delete "375-380" and insert :—

**SAFETY FIRING GEAR FOR THE ROCKET FLARE LAUNCHERS****Plate 24B**

375. The safety firing gear for the launchers consists of a safety firing switch (A.P. 5061 modified) operated by a spring-loaded plunger and roller which rides on a cam rail when the mounting is trained on a dangerous bearing.

**OPERATION**

When the mounting is trained on to a dangerous bearing, the spring-loaded plunger is forced up as the roller travels along the incline of the cam rail and operates the safety firing switch which opens the firing circuits.

The firing circuits are shown in Plate 36B.

Complete detail of the operation of the rocket flare launcher is given in B.R. 924.

376-380.

(G. 01894/49.—A.F.O. P.255/50.)



## CHAPTER V

### SECTION 1—TRAINING GEAR

#### Plate 27

381. The training gear is operated from the right-hand side of the mounting by means of two **handles** attached to crank arms which are carried by a **support bracket** fastened to the carriage.

382. A ball race is fitted in a cap at the top of the support bracket and forms the bearing for the crank arm shaft.

383. The drive from the handles turns a pair of bevel wheels in the **upper bevel gear box** and is transmitted through the **bevel gear shaft** to another pair of bevel wheels in the **lower bevel gear box** and thence to the **worm shaft**.

384. The bevel gear shaft is made in three parts joined by sliding couplings to facilitate stripping. A hole is provided in the carriage side to enable the worm shaft to be removed.

385. The trainer is provided with an adjustable **seat** and adjustable **foot rest** secured to the platform, and the **training receiver** is conveniently situated in front and slightly towards his right.

The forward or clockwise movement of the handles trains the mounting to the right, one complete turn of the handles training the mounting through 4 deg.

#### STRIPPING

386. (1) Remove the split pin securing the inner crank handle lever to the bevel box driving shaft.

(2) Disconnect the support bracket cap and remove it and remove the driving handles and crank levers.

(3) Drain upper bevel gear box, remove outer cover, together with driving shaft and driving bevel wheel.

(4) Take out upper and lower shaft coupling bolts and remove the centre portion of the shaft, one-half coupling being arranged so as to withdraw along its shaft and disengage its spigot from the faucet of the mating coupling.

(5) Remove the upper bevel gear box, together with the upper driving shaft and pinion.

(6) Remove the lower bevel gear box cover, together with the lower driving shaft and pinion.

(7) Take out the plug for access to worm shaft to facilitate the withdrawal of the shaft, and remove the securing nut for the bevel wheel. Take off the cover on the worm gear box for access to the worm.

(8) Withdraw the worm shaft, remove worm and thrust bearings, also worm shaft bevel wheel.

(9) Take out the bolts securing the worm gear box and remove complete.

*Note.*—If required, the lower bevel gear box, worm shaft and worm gear box can be removed intact to the bench for inspection and stripping down.

#### LUBRICATION

387. All gears run in oil baths, and lubrication is provided to all ball races.

#### TRAINING WORM GEAR DRIVE—MARK XIX MOUNTING

#### Plate 28

388. The training pinion is positioned at the front of the mounting, on the fore and aft centre line, and is driven by a worm shaft, through a worm, wormwheel and friction gear.

389. The worm shaft is operated by the training handles through an upper and lower pair of bevel wheels, the latter being indicated on the plate.

390. The worm gear box is spigoted in the top racer carriage plate and secured by tap bolts, while a thrust key is fitted which registers the position of the box with relation to the carriage plate.

The worm is non-reversible and runs in an oil bath formed in the gear box.

391. Oil baffles formed on the underside of the wormwheel and in the gear box prevent the leakage of oil past the vertical pinion shaft.

392. The wormwheel is hollow and contains the friction discs. Alternate steel and gun metal friction discs are assembled in the wormwheel.

393. The steel discs (yellow) are keyed to the pinion shaft and the gun metal discs (orange) are keyed to the inside of the wormwheel. Tapped holes are provided in the discs to facilitate their withdrawal.

394. The friction discs are loaded by Belleville washers which bear down upon the washer "A." Washer A is keyed to the shaft as also is the other washer or distance plate. The nut is screwed down



and compresses the Belleville washers. It is prevented from unscrewing by the **locking plate** which is let into the distance plate. The amount of compression is such that the clutch will not render unless a force of approximately seven tons is applied at the training rack.

395. The nut, locking plate, distance plate, Belleville washers, adjustment washer, washer A and the steel friction discs rotate, as one with the pinion shaft.

Ball thrust bearings are arranged at each end of the worm shaft to take the axial thrust in either direction.

396. A screwed adjusting bush is fitted to take up any slackness in the worm thrust bearings which may occur through wear.

When stripping down, the adjusting bush should not be touched once it is set, unless it is necessary.

### THE TRAINING WORM GEAR DRIVE—MARK XX MOUNTING.

#### Plate 29

397. The training pinion is positioned at the front of the mounting, on the fore and aft centre line, and is driven by a worm shaft, through a worm, wormwheel and friction gear.

398. The worm shaft is operated by the training handles through an upper and lower pair of bevel wheels, the latter being indicated on the plate.

399. The worm gear box is spigoted in the top racer carriage plate and secured by tap bolts, while a thrust key is fitted which registers the position of the box with relation to the carriage plate.

The worm runs in an oil bath formed in the gear box.

400. The wormwheel is hollow and contains the friction discs. Alternate steel and gun metal friction discs are assembled in the wormwheel.

401. The steel discs (yellow) are keyed to the pinion shaft and the gun metal discs (orange) are keyed to the inside of the wormwheel. Tapped holes are provided in the discs to facilitate their withdrawal.

402. The friction discs are loaded by Belleville washers which bear down upon the washer "A." Washer "A" is keyed to the shaft as also is the other washer or distance plate. The nut is screwed down and compresses the Belleville washers. It is prevented from unscrewing by the **locking plate** which is let into the distance plate. The amount of compression is such that the clutch will not render unless a force of approximately one ton is applied at the training rack.

403. The nut, locking plate, distance plate, Belleville washers, adjustment washer, washer A and the steel friction discs rotate as one with the pinion shaft.

Ball thrust bearings are arranged at each end of the worm shaft to take the axial thrust in either direction.

404. A screwed adjusting bush is fitted to take up any slackness in the worm thrust bearings which may occur through wear.

When stripping down, the adjusting bush should not be touched once it is set, unless it is necessary.

405—410.

### CH. V. SECTION 2—TRAINING BUFFER, TRAINING LIMIT STOP AND HOUSING LOCKING BOLT

#### Plate 30

411. The design of the training buffer is such that the plunger moves back to the normal out position with a quick return motion.

412. The training buffer contains two cylinders filled with oil in which works the plunger with a central collar.

413. In each cylinder there is a thrust ring and a loose piston which are grooved. The piston is normally kept central by springs.

414. The action of the **training buffer** is as follows:—When the **plunger** comes against the training stop, assuming that the buffering takes place from the right-hand side, the spring is compressed in the left-hand chamber until the **collar** on the plunger comes into contact with the **loose piston**.

This seals the oil in the left-hand chamber except for the small escape groove in the periphery of the piston.

415. When the mounting is trained off the stop, in the reverse direction, the spring acting on the **thrust ring** separates the collar on the plunger from the loose piston allowing the oil to escape through the grooves in the thrust ring and causing a quick return.

416. In order to fill the buffer rapidly, the **pin** in the bracket carrying the buffer may be withdrawn and the buffer placed on end.

The retaining nut can be unscrewed and the chamber completely filled.



417. Before replacing the retaining nut the valve plug should be removed to allow any air to Page 35, paragraph 418. *Cancel and substitute :—*

"418. The housing bolt works through a bracket fitted to the right rear of the top racer carriage. It is operated by hand and a locking pin secures it both in the 'secure' and in the 'free' positions the right of the mounting as required.

A stop piece is secured to the top of the housing bolt bracket in such a position as to prevent the locking pin being inserted in the upper hole of the bolt above the bracket (Plate 30A).; and are

For later mountings the housing bolt bracket is fabricated, the housing bolt handle is at the top of the bolt, and a locating screw keeps the bolt in alignment with the bracket as shown on Plate 30A.

To secure the mounting, the bolt is engaged in the housing stop on the lower racer base plate."

420. One Tucker's oiler in the training runner. (G. 06265/47.—A.F.O. P.355/47.)

One Enot's lubricator in the housing locking bolt bracket.

421—425.

## CH. V. SECTION 3—TRAINING RECEIVER—MECHANICAL POINTER DRIVE

### Plate 31

426. The **training receiver** is provided with a mechanically operated "follower" pointer which is driven through a split pinion (spring loaded to reduce backlash), shafting and bevel gearing (blue) from the **training rack**. The shaft can be readily removed by withdrawing the split pins from the muff couplings at either end and sliding them inwards.

The receiver has a jaw coupling which engages with a corresponding member on the driving shaft ; this allows for easy removal of receiver.

427. A **vernier adjustment** is inserted in the drive, just below the training receiver, to facilitate lining up the pointer.

428. Adaptors are provided for receivers of other types (typical examples illustrated on plate).

429. Provision is made, in the case of receivers having the jaw coupling situated at the rear, for extending the drive through the small bevel gears.

430. The gear ratio can be altered to suit the small type training receivers by introducing a pair of spur wheels, housed in the adaptor.

431. The direction of rotation of the pointers in small type training receivers may be reversed by altering the position of the main bevel drive in the instrument.

432. A wormwheel driven by the worm in the training receiver drive operates the drive (green) to the Evershed bearing receiver, where fitted.

### ADJUSTMENTS

433. To line up the pointer :—

(1) Slacken back the vernier adjustment coupling nut and slide the clutch sleeve back, releasing the clutch plate.

(2) Line up the pointer by rotating the jaw coupling until the correct setting is obtained.

(3) Rotate the clutch plate until a position is found where the serrations on each side coincide with the serrations on the clutch sleeve and the dog clutch.

(4) Slide the clutch sleeve forward and replace the coupling nut, finally locking with the grub screws.

### LUBRICATION

434. Oilers provide lubrication to the gear wheels, and grease gun nipples are fitted in positions indicated on the plate.

435—440.



## CHAPTER VI

## SECTION 1—THE SIGHTING ARRANGEMENTS

## Plates 32, 33, 34, 35

441. The sights are of the all-gear type and are mounted on the fixed structure of the mounting. They are connected to the cradle through gearing enclosed in a **gear box** which is keyed and bolted to a facing on the left-hand side of the carriage.

442. The **elevation cross-connecting tube** is supported in **sight trunnions** fixed to the carriage structure and carries at either end **elevating brackets** to which **deflection arms** are pivoted. The deflection arms carry the layer's and trainer's telescopes and are connected to the **deflection cross-connecting shaft** by **swivel pins** and **trunnion blocks**. The sight as a whole is balanced about the sight trunnions by a **balance weight** secured to the elevation cross-connecting tube.

443. The operation of the sight is as follows:—

(1) **SETTING RANGE**

Range is set by turning the **range handwheel** and is passed by the gearing (coloured yellow) to the **differential gear** which operates the **elevation shaft**. An **elevation wormwheel segment** turns the elevation cross-connecting tube and moves both telescopes simultaneously in elevation or depression. As range is increased the telescopes are depressed and *vice versa*.

(2) **GUN ELEVATION**

As the guns are moved by the layer, the **sight arc**, attached to the cradle concentrically with the gun trunnions, revolves the **sight pinion** which drives gearing (coloured mauve) and operates the differential gear and elevating brackets as before.

Thus operations (1) and (2) are combined as follows:—

When range is increased the line of sight is depressed. On elevating the guns to bring the line of sight on to the target, the guns are laid to the correct tangent elevation. Similarly, if range is decreased the line of sight is raised and the guns are depressed till the line of sight is again horizontal.

(3) **DRIFT CORRECTION**

As range is set on the sight a correction for drift is automatically applied by the drift gearing (coloured red) which is operated by means of a bevel secured to the **range shaft extension**. The **drift wormwheel** is a sliding fit on the splines of the deflection cross-connecting shaft, a screwed portion of which engages with an internally threaded sleeve incorporated in the **deflection wormwheel**. The deflection cross-connecting shaft is therefore rotated in the screwed sleeve and moves endwise, imparting a small angular movement to the telescopes.

(4) **LATERAL DEFLECTION**

Lateral deflection is applied by rotating the **deflection handwheel** and is passed by the gearing (coloured green) to the deflection wormwheel. The latter incorporates an internally threaded sleeve into which the deflection cross-connecting shaft is screwed. The deflection wormwheel is constrained from endwise movement and in rotating moves the shaft laterally. A lateral angular movement is therefore imparted to the telescope through the trunnion blocks and swivel pins in the deflection arms.

**TELESCOPES**

444. The telescope holder brackets are arranged to take either Ross or Ottway monocular telescopes together with Aldis unit telescopes. All telescopes have fore and aft adjustment in their clips.

**STAR SHELL SPIRIT LEVEL**

445. A facing is provided on the deflection arm at the layer's position to carry the star shell spirit level which should be shipped in position only when firing star shell. A stowage position is provided on the carriage for the star shell spirit level when not in use.

**BARRAGE SIGHTS**

446. Barrage sights are fitted at the layer's and trainer's positions, each consisting of a bead rear sight and a double ring foresight. The outer ring corresponds to a target speed of 200 knots and the inner ring to a speed of 100 knots. A line of sight through the centre of the bead to the outer edge of the rings gives the approximate deflection necessary for these target speeds.

The barrage sights shown are of the type fitted to later mountings and are permanently attached to the elevating brackets.

Barrage sights supplied for earlier mountings are attached to a tube and, when required for use, should be fitted in place of the Aldis tubes.

**SAFETY TRAINER'S SIGHT**

447. A simple type of Vee and bead safety trainer's sight can be mounted on the left or right side of the gun shield. A stowage box is provided on later mountings for this sight when not in use.

"A Local Control Officer's sight is being fitted on all mountings in lieu of the safety trainer's sight. It has been devised with the object of enabling the O.O.Q. to direct the layer and trainer on to the target, voicepipes being provided for this purpose. The sight is secured to the trunnions and can be fitted either side of the mounting. The platform provided for the O.O.Q. is collapsible so that, in the case of blast screen mountings, it can be folded out of the way when the mounting is trained inside the screen."



### ADJUSTMENTS

448. **For elevation.** The sequence and method of adjustment are as follows:—

Set the layer's telescope parallel to the gun bore by means of the range handwheel and set the range dial to zero. Bring the trainer's telescope into line by the **adjustment for elevation** provided on the telescope holder. This adjustment is the usual type of eccentric bolt and block.

449. **For line.** The sequence and method of adjustment are as follows:—

Set the layer's telescope parallel to the gun bore by means of the deflection handwheel and set the deflection dial to zero. Bring the trainer's telescope into line by the **adjustment for lateral lining-up** provided at the trainer's end of the deflection cross-connecting shaft. This adjustment is in the form of two domed check nuts and a sleeve housed in the trunnion block.

450. **Stop gear on range handwheel.** The required movement of the telescopes in elevation is 30 deg. tangent elevation (movement below line of gun) and 5 deg. tangent depression (movement above line of gun).

Set the telescopes to 5 deg. tangent depression by means of the range handwheel. The range index will then coincide with the "setting mark for dial at stop position" and the stop gear should be set to act exactly at this position, so that, when changing dials to correct for a variation in m.v., a setting point is always maintained. To adjust the stop gear: slacken both bolts in the flange behind the range handwheel and withdraw the handwheel and spindle sufficiently to disengage the bevel gear on the spindle. Rotate the handwheel, in the direction necessary to set tangent depression, until the stop acts. Push handwheel back to remesh the gear and tighten the bolts.

451. **Stop gear on deflection handwheel.** The required movement is 100 units R. or L. deflection and the stop gear is set in a manner similar to that for the range stop, allowing each maximum dial reading to be over-run by the same amount.

452. **Barrage sight.** **Adjustment for vertical lining-up** is provided on the foresight where the holes for the securing screws are elongated vertically. **Adjustment for lateral lining-up** is provided on the bead rear sight in the form of two check nuts.

453. **Anti-Backlash.**—The elevation worm, deflection worm and the worm on the vertical shaft in the drive from the range handwheel are split to permit adjustment for wear. The wormwheel on the deflection dial spindle and the spiral gear wheel on the range dial spindle are also split. One-half of each wheel is mounted on a spiral key so that adjustment may be made by introducing a shim between the halves of the wheels.

Backlash in the thread of the sleeve and the deflection cross-connecting shaft is eliminated by an **anti-backlash spring** loaded in excess of the effort required to produce right or left deflection and which thus maintains pressure in one direction on the screw.

### LUBRICATION

454. Drip feed lubricators provide lubrication for the elevation worm and segment, the upper drift bevels, the spiral gear driving the range dial and the worm gear driving the deflection dial. Plugs and a cover suitably engraved are provided to give access to the remaining gearing and to the oilers for the drift worm spindle. Grease gun nipples are fitted for lubrication of all other working parts and drain plugs are provided at two points in the sight gear box. *See plate 40.*

### STRIPPING

455—(1) Disconnect cables and remove lamps from **range** and **deflection dials**. Remove range and deflection index brackets. Remove range and deflection dials by detaching clamping plates. Remove dial holders from ends of spindles. Drain all oil from the **gear box**.

(2) Remove both covers on upper portion of gear box and withdraw range dial spindle complete with spiral gear wheel.

(3) At both sides of the sight, extract bolts securing the swivel pins in the deflection arms and remove swivel pins. Swing the deflection arms clear of the trunnion blocks.

(4) Remove deflection pivot pins and detach deflection arms.

(5) Remove cover from power portion of gear box.

(6) Remove nuts from lower end of deflection shaft and extract taper pin in combined bevel gear and worm at upper end of shaft.

(7) Tap deflection shaft upwards and withdraw it from gear box and remove distance pieces, thrust washers and worm as released. *Note.*—If gun shield is in position, withdraw shaft sufficiently to release deflection worm and leave shaft in position until gear box is detached from carriage.

(8) Remove deflection dial spindle and wormwheel.

(9) Remove bevel gear on vertical shaft in drive from range handwheel.

(10) Remove plug on top of gear box. Tap shaft upwards and remove worm, distance pieces and thrust washers as shaft is withdrawn.

(11) Remove drift bevel wheel at lower end of range shaft.

(12) Extract taper pin in distance piece adjacent to differential and taper pins in spiral gear pinion and wormwheel.



- (13) Withdraw range shaft from gear box and remove parts thus released.
- (14) Release and withdraw cover over double thrust washer on **elevation shaft**. Extract taper pins in collar on elevation shaft.
- (15) Remove bevel gear from end of elevation shaft. Withdraw elevation shaft into upper portion of gear box and remove parts thus released. Remove elevation shaft by passing it through lower portion of gear box.
- (16) Remove **trunnion block** at trainer's side of deflection cross-connecting shaft by unscrewing domed nut and check nuts.  
Extract taper pin in nut for **anti-backlash spring**. Unscrew nut and withdraw spring.
- (17) At layer's side remove cheese head screws behind deflection wormwheel. Withdraw deflection wormwheel complete with cross-connection from the gear box. (To facilitate dismantling in a limited space the cross-connecting shaft may be withdrawn in sections by extracting the taper pins in the cross-connecting tube.)
- (18) Remove bolts securing **elevation wormwheel segment** to elevating bracket and withdraw segment.
- (19) Remove bolts securing sight gear box to carriage and remove gear box. (Holes are provided in the left-hand elevating bracket so that a small drift may be used to release ball bearing.)
- (20) Remove bolts securing trunnion bracket to carriage. Remove trunnion bracket together with elevation cross-connecting tube, balance weight and elevating brackets.
- (21) Remove the set screws positioning balance weight on tube. Remove keeps to release balance weight.
- (22) Remove check nuts from trainer's end of cross-connection tube and withdraw elevating bracket.
- (23) Remove cover on trunnion bracket and remove ball bearing. (Holes are provided for use of a small drift for this purpose.)
- (24) Remove cover plate retaining ball bearing in gear box and withdraw ball bearing. (Holes are provided for use of a drift for this purpose.)
456. Re-assemble in reverse order. *Before re-assembly of cover referred to in paragraph 455 (14), the cover should be filled with grease.*
- 457-460. (G. 4422/47 - R.F.O.P. 388/10)

## SECTION 2—METHOD OF SIGHT TESTING

### PARALLELISM TEST

461. **Purpose.**—To see that the line of sight is parallel to the gun bores.

462. **Procedure.**—Bore telescopes and muzzle crosswires should be shipped and lined up on a target board marked out in accordance with diagram "A" or "B," and set up at some convenient distance normal to the gun bores. The crosswires of the gun sighting telescopes should now be found to be aligned exactly on their corresponding crosses on the board. If necessary, adjustment should be carried out in accordance with the paragraphs 448, 449.

If preferred, the use of a target board may be dispensed with by lining up both gunsighting and bore telescopes on some distant object (e.g., a church spire).

### GRADUATION TEST

463. **Purpose.**—To check agreement of guns, telescopes and range dial graduations.

In carrying out this test it should be observed that in order to determine the amount of backlash in the gearing, two readings are taken for each gun elevation, one lowering and the other raising the sight. It is therefore apparent that each setting of the sight should be approached carefully in the direction indicated without over-running and returning.

464. **Procedure.**—(1) Ship dummy telescope (1 per "C" set) in place of layer's monocular telescope.

(2) Place clinometers on the planes provided on both gun and dummy telescope.

(3) Set guns and telescopes horizontal and adjust range dial (M.V. 2,650 f.s.), if necessary, by releasing clamping plate and re-setting to read zero range against index.

(4) Elevate guns to first value shown in left-hand column of table.

(5) Depress sight to horizontal position by means of range handwheel and note range dial reading.

(6) Depress sight still further a small amount, return to original setting and again record range dial reading.

(7) Repeat above process for all values shown in left-hand column of table.



DIAGRAM A  
4-INCH H.A. TWIN MOUNTING MARK XIX (INCLUDING R.P. 50 SERIES)  
DIAGRAM OF SIGHT TESTING BOARD





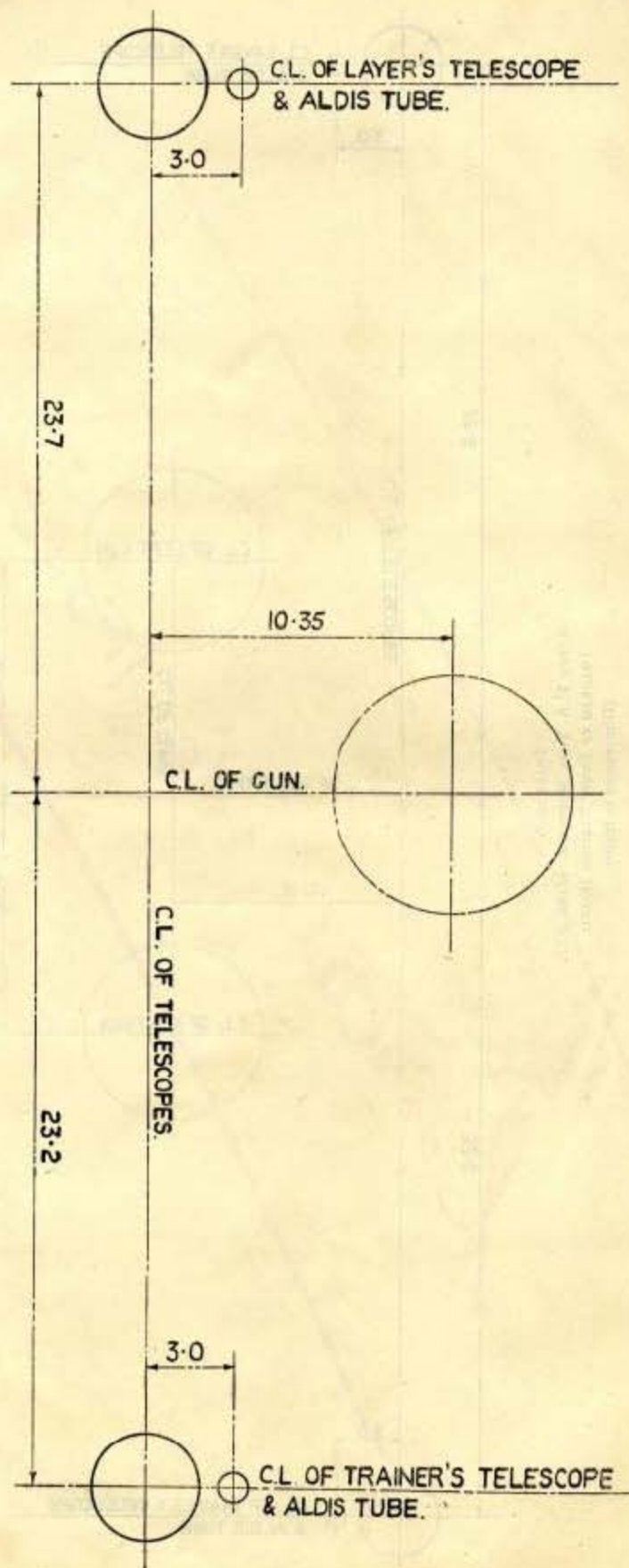


Diagram B  
4-INCH H.A. MOUNTING, MARK XX  
Diagram of Sight Testing Board  
\* (Dimensions in inches)



Tabulate as below :—

Elevation of Gun with Sight Horizontal	Corresponding Range from Sight Testing Table Yards	Range on Sight			
		Lowering the Sight		Raising the Sight	
		Reading Yards	Error Yards	Reading Yards	Error Yards
Degs.					
1	2,233				
2	3,939 etc.				

The test is considered satisfactory if the ranges indicated are within 25 yards of those shown in the table.

### DEFLECTION TEST

465. **Purpose.**—To check the accuracy of the deflection gearing and deflection dial graduations. It should be noted that two readings are taken for each deflection setting, one increasing and the other decreasing deflection, in order to measure the amount of backlash in the gearing. Care should therefore be taken to approach the deflection setting in the manner indicated without over-running and returning.

466. **Procedure.**—(1) Mark off target board as shown on diagram "C."

(2) Lay the guns horizontal, train the mounting on to a suitable bearing, and set the deflection dial to zero by operating the deflection handwheel.

(3) Place the board at a distance of exactly 25 ft. from the centre pivot of the mounting, adjusting it square to the sight line and level so that the crosswires of both layer's and trainer's telescopes are on the zero lines.

(4) Apply left deflection by rotating the deflection handwheel until the crosswires of the trainer's telescope are on the first setting mark on the board and note the deflection dial reading.

(5) Increase the deflection slightly, return the telescope to its original setting, and again note the reading on the dial.

(6) Repeat (4) and (5) above, using the layer's telescope, taking care to approach the setting in a similar manner to that for the trainer's telescope. Note the deflection dial readings.

(7) Repeat the above sequence of operations for all deflection setting marks for both right and left deflection.

Tabulate as below, observing that a comparison of the readings for layer's and trainer's telescopes serves as a check for the accuracy of the cross connection :—

Lateral Deflection of Telescope. Right or Left (Units)	Deflection Dial Readings (in units)							
	Trainer's Telescope				Layer's Telescope			
	Left Deflection		Right Deflection		Left Deflection		Right Deflection	
	IN-CREASING	DE-CREASING	IN-CREASING	DE-CREASING	IN-CREASING	DE-CREASING	IN-CREASING	DE-CREASING
10								
20								
30								
etc.								

The test is considered satisfactory if the readings obtained are within  $\frac{1}{2}$  unit (3 minutes) of those shown in the left-hand column of the table above.

### DRIFT CORRECTION TEST

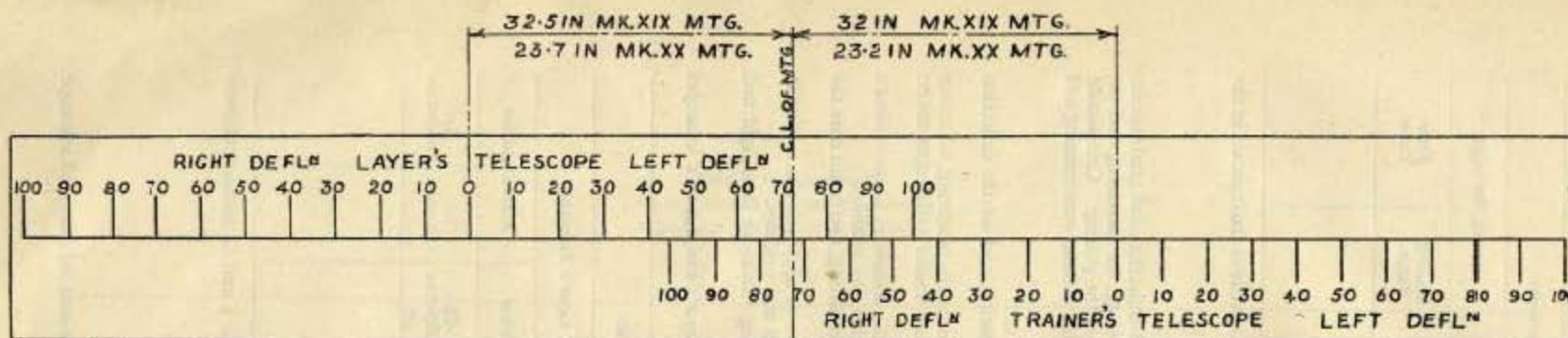
467. **Purpose.**—To check accuracy of drift mechanism.

468. **Procedure.**—(1) Set deflection dial to zero.

(2) Secure dummy telescope in place of layer's monocular telescope and set guns and telescope horizontal by clinometers.

(3) Remove dummy telescope and replace monocular telescope.





LATERAL DEFLECTION OF TELESCOPE, RIGHT OR LEFT.	DEFLECTION DIAL READINGS, RIGHT OR LEFT.	DISTANCE OF GRADUATION FROM ZERO IN INCHES.				
		LAYER'S TELESCOPE - RIGHT DEFLN.		LAYER'S TELESCOPE - LEFT DEFLN.		
		TRAINER'S TELESCOPE - LEFT DEFLN.		TRAINER'S TELESCOPE - RIGHT DEFLN.		
DEGS.	MIN.	UNITS.	MK. XIX MTG.	MK. XX MTG.	MK. XIX MTG.	MK. XX MTG.
1	0	10	4.54	4.57	4.54	4.57
2	0	20	9.08	9.15	9.08	9.15
3	0	30	13.63	13.74	13.62	13.73
4	0	40	18.19	18.33	18.17	18.31
5	0	50	22.76	22.94	22.73	22.91
6	0	60	27.35	27.56	27.31	27.52
7	0	70	31.95	32.2	31.9	32.14
8	0	80	36.58	36.86	36.5	36.78
9	0	90	41.23	41.54	41.13	41.45
10	0	100	45.9	46.26	45.79	46.14
TARGET BOARD TO BE SET AT A DISTANCE OF 25 FEET FROM C.L. OF PIVOT OF MTG.						

DIAGRAM C  
DIAGRAM OF DEFLECTION  
TARGET BOARD  
(Above)



(4) Set a target board marked with a cross (the deflection target board may be used) at a convenient distance from the mounting and adjust it until the horizontal and vertical lines of the cross coincide exactly with the crosswire of the telescope.

(5) Elevate the gun and set by clinometer to the first value given in the left-hand column of the table of "drift correction readings."

(6) Operate the range and deflection handwheels of the sight until the telescope crosswires again coincide exactly with the target cross and note the deflection dial reading.

(7) Repeat for all values given in the Table and Tabulate as shown.

An alternative but less accurate test can be carried out without the use of a clinometer as follows:—

(1) Use a target board as above (for this test it is not necessary for target cross to be horizontally opposite to the telescope).

(2) Set range dial to read zero range, and operate the training and elevating handles of the gun to bring the layer's telescope crosswires to bear on the target cross.

(3) Set range dial to reading given in centre column of table of "drift correction readings."

(4) Operate elevating handles and deflection handwheel to bring telescope crosswire to bear again on the target cross and note deflection dial reading.

(5) Repeat for all values given in the table and tabulate as shown, substituting range for elevation in the first column.

Gun Elevating with Sight Horizontal	Deflection Dial Reading		Error + or -
	From Tables	Actual	
Degs. 5	Units 0	Units 0	Units 0
10 etc.			

469. The test is considered satisfactory if the deflection dial readings obtained are within  $\frac{1}{2}$  unit (3 minutes) of the value shown in the right-hand column of the drift correction table.

470-475.

### SIGHT TESTING TABLE

#### RANGE DIAL READINGS. FULL CHARGE—MARK XVI\* GUN. M.V. 2,650 F.S.

*In agreement with Range and Elevation Scales No. 370.*

Gun Elevation with Sight Horizontal	Range Dial Reading
Degs.	Yards
0	0
1	2233
2	3939
3	5316
4	6471
5	7466
6	8337
7	9108
8	9795
9	10410
10	10964
11	11484
12	11970
13	12431
14	12879
15	13308
16	13714
17	14113
18	14488
19	14847
20	15194



SIGHT TESTING TABLE—continued

Gun Elevation with Sight Horizontal	Range Dial Reading
<i>Degs.</i>	<i>Yards</i>
21	15527
22	15842
23	16150
24	16445
25	16732
26	17005
27	17270
28	17525
29	17772
30	18008

DRIFT CORRECTION READINGS. FULL CHARGE—MARK XVI\* GUN. M.V. 2,650 F.S.  
DRIFT CONSTANT 120.

Gun Elevation with Sight Horizontal	Range Dial Readings	Deflection Dial Reading
<i>Degs.</i>	<i>Yards</i>	<i>Units</i>
0	0	0
5	7466	1.96
10	10964	3.92
15	13308	5.87
20	15194	7.83
25	16732	9.79
30	18008	11.75

## CH. VI. SECTION 3—ELECTRICAL CIRCUITS

Plates 364-369.

476. Two **Junction Boxes**, one on the left-hand side, the other on the right-hand side of the carriage, are fed by flexible cables from the junction box on the **Fixed Structure**, and led through the pivot of the Mounting.

### FIRING CIRCUITS

477. The guns are fired electrically by the Director, either together or separately. When firing separately the interceptor of the gun which is not to fire must be opened.

At each gun the main and auxiliary director firing circuits are led into the **Gun Layer's C.O.S.** which also receives the circuit from the local firing contacts. The C.O.S. has two positions:—

**DIRECTOR FIRING** and **LOCAL**.

SEE ALSO PARAGRAPH 8.

### INTERCEPTORS

478. Mark IV interceptors, which work in conjunction with the safety firing gear, are fitted. They are of the falling contact type, the upper portion being fixed to the breech and the lower to the cradle. ~~A push pull switch is incorporated in each interceptor for changing over from main to auxiliary circuit.~~

Single leads connect the interceptors to their respective **Breech Safety Contacts**. ~~marks to interceptors are fitted to some mountings with safety firing switch gear in lieu of safety firing gear.~~

### INSTRUMENT ILLUMINATING CIRCUITS

479. Instrument illuminating circuits are embodied in the instrument cables and are controlled by a switch on the mounting.

Sighting gear lamps are controlled by **Dial Lamp Switches** and **Night Sight Switches**. The two **Loading Lights** are controlled on the mounting.

The modified circuits and cable Pattern Numbers, and the additional circuit, for the duplicate H.A. Control, are shown as an inset on the plate.



## CH. VI. SECTION 4—DISMOUNTING GEAR FOR CHANGING LOOSE BARRELS

## Plate 37.

485. This gear is provided to enable loose barrels to be changed while the jacket of gun remains in the mounting.

486. The structure consists of two crossbeams bolted to and supported by two forward and two after vertical pillars which are kept in position by fore, aft and cross ties.

487. Guy wires are attached to shackles fitted to crossbeams and secured to any convenient deck fitting.

488. Stays are also secured to the forward pillars and attached to lugs fitted to the carriage of mounting.

489. The bottom flanges of the crossbeams serve as a runway for the two travellers to which the traveller beam is bolted.

490. Sheaves for the lifting wire for removal (a) of the breech ring and (b) of the loose barrel are situated at the forward and rear end of the traveller beam and a pul-lift tackle is arranged as shown.

491. Two trolleys for supporting and removing the loose barrel run on the traveller beam.

492. The barrel starting gear is arranged inside the barrel and the strong back, to start the barrel, is positioned on the rear face of the balance ring.

Note.—(i) The screwed plug at the forward end of the barrel starting gear has a rounded edge to avoid damage to the inside of the jacket and to the threads of the breech ring.

Note.—(ii) It has been found when unscrewing the breech ring preparatory to the removal of the loose barrel that it is of great assistance to have some indication of when the breech ring has rotated to the unlocked position.

An arrow and line are accordingly being engraved on the breech ring and face of the balance ring in guns and mountings under manufacture, and the opportunity should be taken, when barrels in guns already afloat are removed, to engrave these indicating marks by ship's staff.

## INSTRUCTIONS FOR CHANGING LOOSE BARRELS OF 4-IN. MARK XVI\* GUNS ON 4-IN. TWIN MARK XIX MOUNTINGS

## 493. PREPARATION

(1) Train mounting — as to (1) — (2) Table bearing other maximum amount of — — — — —

Page 45. Paragraph 493.

Amend (2) and (3) to read as follows:—

✓ (2) Lay guns horizontal. A block should be placed under the balance weight of the gun from which the barrel is not being removed.

✓ (3) Remove breech mechanism, hand operated firing gear, hand trigger, firing bar, firing lever, thumb lever releasing B.M. lever, clinometer surface cover plate." (G. 04086/50.—A.F.O. P. 9/51.)

Add at end of paragraph:—

"Note.—Operations (5), (6), (7) and (8) need not be carried out till after the erection of the structure."

(G. 04086/50.—A.F.O. P. 9/51.)

## TO ERECT THE STRUCTURE

494. On account of difficulty that may be met in placing new barrels within the feet of the pillars of the structure due to lack of space in rear in which to handle them, they should be placed to rear of mounting on wood blocks before the structure is erected.

(1) Bolt the tie and the crossbeam to the forward pillars. Similarly bolt the tie and crossbeam to the after pillars. Where the mountings are on a 6-in. packing ring, bolt distance pieces to the pillars.

✓ Paragraph 494. After (1), add note as follows:—

"Note.—When bolting the cross beams to the pillars, it should be noted that the latter are handed by the position of the boss for the cross tie securing nuts, the bosses facing outwards in each case."

(G. 04086/50.—A.F.O. P. 9/51.)

(5) Attach sights to crossbeams and place crosswire sights on the carriage of the gun.

(6) Pack up the pillars by wooden wedges under the feet or under the planks to compensate for the camber of the decks until the centres of all crosswires coincide. Then position the forward sheave to plumb 8 ins. forward of rear face of the breech ring. Secure wedges by nails or lashings to preserve the alignment.

(7) Secure stays to carriage of mounting (one each side), by means of special bolts provided, and using existing holes for  $\frac{3}{4}$ -in. bolts carrying angle bracket supporting the rear platform of mounting.

(8) Remove all sights employed for lining up.

(9) Run trolleys on to traveller beams and bolt on the anchor plate and rear sheave.

(10) Shackle guy wires to crossbeams and secure to any convenient deck fitting.



### TO REMOVE A BARREL

495. Particular care must be taken to avoid damage to threads of the breech ring or to shoulders of the loose barrel. Clearances involved are very small, and the slightest burr on barrel shoulder will prevent it from entering jacket.

(1) Reeve lifting wires over sheaves as shown in Fig. I and secure through "Pul-Lift" block to anchor plate.

(2) Secure clamp around breech ring and run hauling part off at one corner. Plumb the lifting wire so that on hauling on the clamp the breech ring will unscrew.

(3) Unscrew breech ring  $\frac{1}{2}$  turn (45 degs.) until the interrupted thread is disengaged.

*Note.*—It may be necessary to use a wooden spar or handspike to start the breech ring if the thread is tight.

(4) Run gun right out so that breech ring is left hanging clear.

(5) Lower breech ring on to deck, and lay it on a wood packing.

(6) Reeve the lifting wires according to the arrangement shown in Fig. II.

(7) Erect the starting gear inside the gun barrel as shown in Plate 37 (the strongback bearing on the rear of the balance weight), and start to withdraw the barrel.

(8) Secure tackle to eyebolt and pull the barrel out for about a quarter of its length, using a preventer secured to the eyebolt to ensure that the barrel does not run away due to its taper.

(9) Run trolleys along, and take the weight on the rear one by screwing up the nuts evenly. Further withdraw barrel, and take weight on forward trolley, before the barrel leaves the jacket, position the trolleys an equal distance either side of the centre of gravity of barrel. Run barrel out (U.C.C. Mark (marked on barrel) is under gun shown).

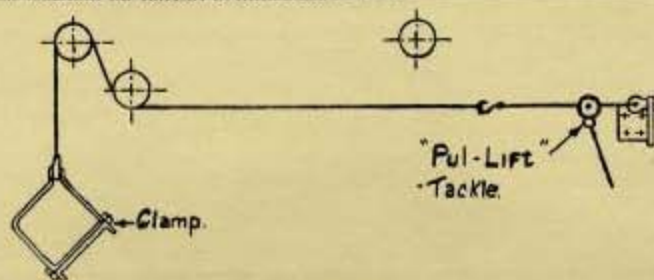


FIG. I

(Amendment No. 27.)

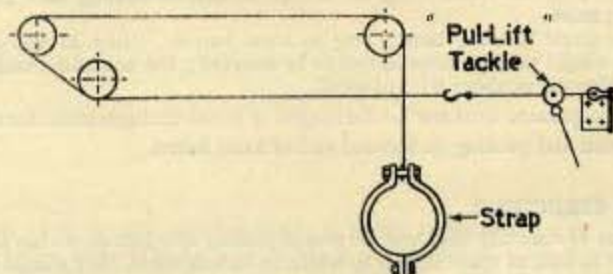


FIG. II

(10) Place lifting strap around barrel at its centre of gravity, and lightly tighten the lower bolt. Secure thimble of lifting wire to lifting strap by upper bolt. Take the weight through the "Pul-Lift" block.

(11) Remove pins in trolleys allowing the vee blocks to fall, and keep muzzle end of barrel slightly lower than breech end to prevent slipping in the lifting strap.

(12) Lower the barrel on to wooden blocks placed on deck to prevent weight being taken on the cross ties.

### REPLACING A NEW BARREL

496. The reverse procedure should be adopted, taking care before inserting barrel that:—

(a) Muzzle end of barrel is concentric with the jacket.

(b) Bore of barrel is parallel with the underside of the travelling beam. To effect this, adjust lifting screws until the measurement—distance of top of barrel below beam plus half diameter of barrel—is equal at either end of the traveller beam.

*Note.*—Further slight adjustment may be needed due to the bending of the beams under load.



497. Grease barrel, and when conditions (a) and (b) obtain, insert the barrel in the jacket.

*Note.*—Both left and right barrels should be capable of being withdrawn and replaced without repositioning the structure.

498. When the breech ring is replaced, care must be taken that the surfaces where the balance ring overlaps the breech ring are well served with thick graphited grease. Otherwise rust will occur and the breech ring may be difficult to remove at a subsequent occasion.

#### INSTRUCTIONS FOR CHANGING LOOSE BARRELS OF 4-IN., MARK 16\*, GUNS ON TWIN, MARK 19, MOUNTINGS IN SHIPS NOT EQUIPPED WITH BARREL CHANGING GEAR

499. This operation can be carried out by ship's staff without dockyard assistance provided a derrick of suitable size can be erected and plumbed over the rear of the mounting.

The derrick should be fitted with a 2-ton working topping lift, a 2-ton pul-lift, and 2-ton chain purchase being secured at the head of the derrick.

Carry out the preparations to the gun as described in paragraph 493 1-8.

#### TO REMOVE A BARREL

500. Great care must be exercised in carrying out this operation, to prevent any damage to the threads of the breech ring and the shoulders of the loose barrel. Clearances are very small, and the slightest burr on the barrel shoulder will prevent it from entering the jacket.

(a) Reeve a 2½ in. wire strop around and through the right-hand side of the breech over suitable padding as in Figure III and hook on pul-lift from derrick head.

(b) Unscrew the breech ring one-eighth of a turn at the same time taking up any slack on the pul-lift.

*Note.*—It may be necessary to use a handspike to start the breech ring if the threads are tight.

(c) Run the gun right out so that the breech ring is left hanging clear.

(d) Lower the breech ring on to the deck on to wooden battens.

(e) Train the mounting until the axis of the gun bores is at 100° to the line of the derrick (see Fig. IV).

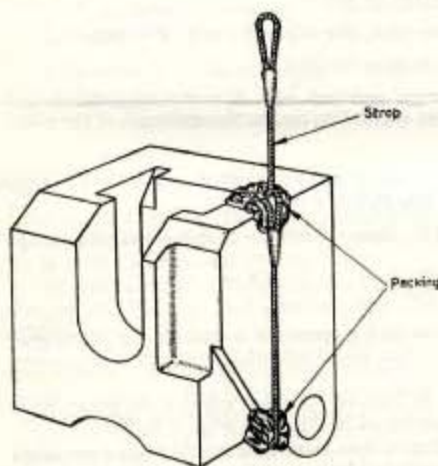


Fig. III

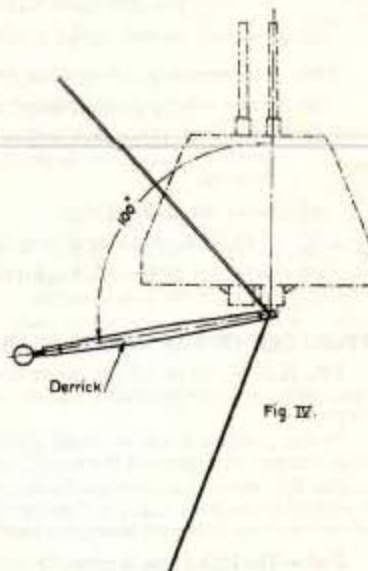


Fig. IV

(f) Knock back the loose barrel until just clear of the jacket and secure a strop with suitable padding around rear end of barrel. Hook the strop to the end of the pul-lift. Insert a baulk of timber in the chamber of the barrel, and lash the strop to it to prevent it sliding along the barrel.

(g) Ease back the barrel at the same time training the derrick away from the mounting.

(h) When the centre of gravity of the barrel is clear of the jacket fit a strop at the centre of gravity (over a suitable packing) and hook on to the 2-ton chain purchase from the derrick head.

(i) Adjust the chain blocks, and work the derrick until the chain purchase is taking the weight and release the pul-lift.

(j) Train the derrick until the barrel is clear of the jacket then lower the barrel on to suitable blocks on the deck.

#### TO REPLACE THE BARREL

501. (a) Thoroughly clean the new barrel of all paint, to prevent any chips being scraped off when replacing the barrel and thus possibly causing the barrel to jam in the jacket.



- (b) Fit strops to new barrel at the centre of gravity and the rear end as on the removed liner. Hoist barrel and enter into the jacket in the reverse order for removal.
- (c) When the barrel is as far home as possible, assemble the muzzle clip (as used in the hauling back gear) to the barrel and train the mounting until the gun is facing some convenient eye-bolt at about the same height on ship's structure and then haul the barrel right home by a pul-lift between the muzzle clip and the eye-bolt.

*Note.*—Should it be found that the new barrel has no muzzleswell it will be impracticable to use the muzzle clip to haul the new barrel home. In this case reeve a wire strop through the bore of the barrel inserting a wooden toggle through the eye at the breech end and hook the pul-lift to the eye at the muzzle end.

- (d) Train the mounting back under the cerrick and replace the breech ring in the reverse order to removal.

502.

## CH. VI. SECTION 5—LIFTING GEAR

**Plate 38.**

503. The mounting can be lifted for the examination of the centre pivot, the training rollers and roller paths, or complete with its base plate as when hoisting it out of the ship, by lifting gear which has been specially designed for this purpose.

The gear consists of a steel **cross beam** from which hang two steel **slings** carrying **saddle pins** at their lower ends.

504. **PREPARATION.**—The following preparatory work must be carried out :—

- (i) remove the cover plates on the top of the shield and expose the holes cut in the shield to allow the lifting slings to pass through the shield.
- (ii) (a) for plain mountings—remove the junction boxes.
- (b) for plain and R.P. 50 series Mountings fitted with safety firing switch gear—remove the operating lever and gear from R.H. trunnion pin.
- (iii) disconnect electric cables in ship's boxes and voicepipe (if fitted).

*Then, if the mounting is being lifted for examination of centre pivot, training rollers and roller paths :—*

- (iv) remove driving pinion bracket and pinion drive to training receiver.
- (v) remove the centre pivot rollers using the forcing screws provided, after first removing the central plate of the drain pump under the mounting and the supporting ring at the underside of the roller bearing.
- (vi) remove the training clips.

*Alternatively, if the mounting is being lifted complete with its base plate :—*

- (vii) remove the 28 hexagon headed holding down bolts  $1\frac{1}{4}$ -in. diameter and the 28 cheese-headed holding-down bolts  $\frac{1}{2}$ -in. diameter.

**APPLICATION OF THE LIFTING GEAR**

505. Having completed the preparatory work for whichever lifting operation is desired, the lifting gear is suspended over the mounting and the saddle pins inserted within the elongated hole cut in each carriage side plate.

In this position it will be found that a **steadying bracket** on each of the slings engages the gusset plate on the carriage and prevents the mounting tilting forward or backward in the slings when it is lifted.

For R.P. 50 series mountings the lifting slings (which are shorter than those used for the plain mountings) are secured to brackets bolted to the sides of the carriage and positioned further up than the saddle pins for the plain mountings, hence the steadying brackets are not required.

*Note.*—The lifting gear is normally retained in the Dockyards and fitting-out Ports.

(G. 602/54.—Amendment No. 26.)



497. Grease barrel, and when conditions (a) and (b) obtain, insert the barrel in the jacket.

*Note.*—Both left and right barrels should be capable of being withdrawn and replaced without repositioning the structure.

Add new paragraph 498:—

" 498. When the breech ring is replaced, care must be taken that the surfaces where the balance ring overlaps the breech ring are well served with thick graphited grease. Otherwise rust will occur and the breech ring may be difficult to remove at a subsequent occasion."

" 499-502."

(G. 06999/43.—A.F.O. P.8/46.)

(Previous amendment No. 11.—A.F.O. P.186/45.)

### Plate 38

503. The mounting can be lifted for the examination of the centre pivot, the training rollers and roller paths, or complete with its base plate as when hoisting it out of the ship, by lifting gear which has been specially designed for this purpose.

The gear consists of a steel cross beam from which hang two steel slings carrying saddle pins at their lower ends.

504. **PREPARATION.** The following preparatory work must be carried out:—

Page 47. Paragraph 504. Preparation.

Delete "(i) remove the shield

(ii) remove both junction boxes" and substitute:—

(i) remove the cover plates on the top of the shield and expose the holes cut in the shield to allow the lifting slings to pass through the shield;

(ii) (a) for plain mountings—remove the junction boxes

(b) for plain and R.P.50 series Mountings fitted with safety firing switch gear—remove the operating lever and gear from R.H. trunnion pin.

(G. 08061/49.—A.F.O. P.21/50.)

ig rollers and roller

fter first removing supporting ring at

THE REMOVAL OF THE TRAINING ROLLERS.

(vi) remove the training clips.

Alternatively if the mounting is being lifted complete with its base plate:—

(vii) remove the 28 hexagon headed holding down bolts  $1\frac{1}{4}$  in. diameter and the 28 cheesc-headed holding-down bolts  $\frac{3}{8}$  in. diameter.

### APPLICATION OF THE LIFTING GEAR

505. Having completed the preparatory work for whichever lifting operation is desired, the lifting gear is suspended over the mounting and the saddle pins inserted within the elongated hole cut in each carriage side plate.

In this position it will be found that a **steading bracket** on each of the slings engages the gusset plate on the carriage and prevents the mounting tilting forward or backward in the slings when it is lifted.

Paragraph 505. "APPLICATION OF THE LIFTING GEAR"

ut Ports.

After line 6 add:— "For R.P.50 series mountings the lifting slings (which are shorter than those used for the plain mountings) are secured to brackets bolted to the sides of the carriage and positioned further up than the saddle pins for the plain mountings, hence the steading brackets are not required."

(G. 08061/49.—A.F.O. P.21/50.)



# APPENDIX I KEY TO LUBRICATION DIAGRAM

## Plate

Position	No.	Total	Type	Location
Cradle .. .. .	1-6	6	Stauflers .. .. .	2 top, 4 bottom, front
	7-12	6	Stauflers .. .. .	2 top, 4 bottom, rear.
	13-20	8	Tuckers oilers .. .. .	Crosshead liners.
Trunnions .. .. .	21-22	2	Stauflers .. .. .	Trunnion caps.
	23-24	2	Enots .. .. .	Trunnion brackets.
	25-26	2	Enots .. .. .	Thrust bearing.
S.A. gear .. .. .	27-30	4	Enots .. .. .	2 on R.H. side, 2 on L.H. side.
	31-35	5	Enots .. .. .	On L.H. side.
	36-40	5	Enots .. .. .	On R.H. side.
Rounds fired counter.. .. .	41-42	2	Springwell .. .. .	1 on L.H., 1 on R.H.
	43-46	4	Springwell .. .. .	2 on L.H., 1 on R.H.
Steadying handle .. .. .	47-48	2	Enots .. .. .	1 on L.H., 1 on R.H.
Liners .. .. .	49-52	4	Enots .. .. .	Recuperator cylinder guides.
Base .. .. .	53	1	Enots .. .. .	Housing stop.
	54	1	Tuckers oiler .. .. .	Hydraulic training buffer.
	55-57	3	Tuckers oilers .. .. .	Clips.
	58-59	2	Oil lubricator, Admiralty Pattern 4790	Centre pivot rollers.
	60-61	2	Rotherham .. .. .	Rollers.
Worm gear box and training gear	62	1	Rotherham .. .. .	Worm gear box.
	63	1	Springwell .. .. .	Worm gear box cover.
	64-67	4	Enots .. .. .	1 on cover and 3 on worm gear box.
	68-69	2	Enots .. .. .	Lower bevel gear box.
	70	1	Enots .. .. .	Bracket for handles.
	71-72	2	Springwell .. .. .	Training handles.
	73-75	3	Enots .. .. .	Upper bevel gear box and covers.
Elevating gear .. .. .	76-77	2	Enots .. .. .	Worm wheel bracket.
	78	1	Rotherham .. .. .	Worm wheel bracket.
	79-82	4	Tuckers oilers .. .. .	Cap for elevating and depression stops.
	83-84	2	Enots .. .. .	Elevating pinion bracket.
	85-89	5	Enots .. .. .	Bevel gear box.
	90	1	Springwell .. .. .	Bevel gear box.
	91	1	Enots .. .. .	Bracket for handles.
	92-93	2	Springwell .. .. .	Bracket for handles.
	94	1	Enots .. .. .	Cam roller.
	95	1	Enots .. .. .	Spring box.
Safety firing gear .. .. .	96	1	Tuckers oilers .. .. .	Nut for spring box.
	97-98	2	Springwell .. .. .	Spring box.
	99	1	Enots .. .. .	Bracket on platform.
	100	1	Enots .. .. .	Lever pivot.
	101-102	2	Springwell .. .. .	Guide bracket for sliding cam.
	103	1	Enots .. .. .	Bracket on carriage.
	143-144	2	Enots .. .. .	Bracket on cradle rear.
	—	—	Oil holes .. .. .	Bell crank lever roller and spring box, R.H. side.
	145-148	4	Enots .. .. .	Front bracket on cradle. 2 on L.H., 2 on R.H.
	149-150	2	Tuckers oilers .. .. .	Bracket on cradle. 1 on L.H., 1 on R.H.
	151	1	Tuckers oilers .. .. .	Lever on cradle.
	104-106	3	Enots .. .. .	Bracket supporting training receiver.
	107	1	Rotherham .. .. .	Cover for gear box.
	108-110	3	Enots .. .. .	Bevel gear bracket. 1 on end cover.
	111	1	Rotherham .. .. .	Cover.
	112-113	2	Rotherham .. .. .	Driving pinion bracket. 1 on end cover.
	114-117	4	Enots .. .. .	Driving pinion bracket.



## APPENDIX I—continued

Position	No.	Total	Type	Location
Drive to elevating receiver ..	118-119	2	Enots .. ..	Bracket supporting elevating receiver.
	120	1	Rotherham .. ..	Bracket supporting elevating receiver.
	121-122	2	Enots .. ..	On pinion gear bracket.
	123	1	Rotherham .. ..	On pinion gear bracket.
	124-125	2	Enots .. ..	On intermediate gear bracket.
	126	—	Rotherham .. ..	On intermediate gear bracket.
Interceptor .. ..	127-142	16	Tuckers oilers .. ..	8 on L.H. interceptor, 8 on R.H. interceptor.
Sights .. ..	—	6 y	Enots .. ..	R.H. side.
See plate 40.	—	4	Rotherham .. ..	L.H. side.
	—	2	Springwell .. ..	
	—	25 y	Enots .. ..	



## APPENDIX II

## ORDNANCE Q.F. 4-INCH MARK XVI\*

## SCHEDULE OF COMPONENT PARTS OF BREECH AND FIRING MECHANISMS

NOMENCLATURE	Index No.	NOMENCLATURE	Index No.
<b>Block, breech—</b>		<b>Counterbalance, breech block, Mark II—</b>	
Body .. .. .	1	Buffer—	
Bush, firing hole .. .. .	2	Bush .. .. .	63
Screw, fixing .. .. .	3	Spring .. .. .	64
Yoke .. .. .	4	Washer .. .. .	65
Rivet, screwed .. .. .	(4 in No.) 5	Rod .. .. .	66
Cover, inner contact .. .. .	6	Sleeve with split keep pin .. .. .	67
Screw, securing .. .. .	7	Nut, spherical with split keep pin .. .. .	69
Screw, preserving .. .. .	(3 in No.) 8	Spring .. .. .	70
Screw, preserving .. .. .	(1 in No.) 8A		
Clip, cable .. .. .	9	<b>Crank, cocking, with rivet .. .. .</b>	72
Screw, fixing .. .. .	10	Roller .. .. .	73
		Screw, securing .. .. .	74
<b>Contact, inner, breech block—</b>		Spindle .. .. .	75
Bush .. .. .	11	Nut with split keep pin .. .. .	76
Bolt .. .. .	12		
Nut, retaining with split keep pin .. .. .	13	<b>Crank, retracting .. .. .</b>	77
Nut, terminal .. .. .	(2 in No.) 14	Roller .. .. .	78
Sheath .. .. .	15	Screw, securing .. .. .	79
Collar .. .. .	16		
Washer, insulating .. .. .	(2 in No.) 17	<b>Spindle cocking and retracting levers .. .. .</b>	80
Sleeve, insulating .. .. .	18		
Spring .. .. .	19	<b>Lever, cocking .. .. .</b>	81
		<b>Lever, retracting .. .. .</b>	82
<b>Contact, outer, breech block—</b>		Roller .. .. .	83
Bolt .. .. .	20	Screw, securing .. .. .	84
Nut, retaining with split keep pin .. .. .	21		
Nut, terminal .. .. .	(2 in No.) 22	<b>Lever, actuating cocking and retracting levers .. .. .</b>	85
Sheath .. .. .	23	Roller .. .. .	86
Collar .. .. .	24	Screw, securing .. .. .	87
Sleeve, insulating .. .. .	25		
Washer, insulating .. .. .	(2 in No.) 26	<b>Bar, recocking .. .. .</b>	88
Spring .. .. .	27	Pin, retaining with split keep pin .. .. .	89
		Plug .. .. .	90
<b>Contact, breech ring—</b>		Spring .. .. .	91
Bolt .. .. .	28		
Nut, retaining .. .. .	29	<b>Shaft, recocking .. .. .</b>	92
Nut, terminal .. .. .	(2 in No.) 30	Nut with split keep pin .. .. .	93
Washer, insulating .. .. .	(2 in No.) 31		
Sleeve, insulating .. .. .	32	<b>Lever, actuating, recocking bar .. .. .</b>	94
		<b>Lever, safety, intermediate .. .. .</b>	95
<b>Cable, breech block contacts .. .. .</b>	33	Pin, axis .. .. .	96
Tag, inner .. .. .	34	Screw, keep .. .. .	97
Tag, outer .. .. .	34A		
		<b>Lever, actuating, recocking shaft .. .. .</b>	98
<b>Case, firing—</b>		Roller .. .. .	99
Body .. .. .	35	Pin, axis .. .. .	100
Cover .. .. .	36	Spring .. .. .	101
Block, needle, part I .. .. .	37	Plunger .. .. .	102
Block, needle, part II .. .. .	38	Nut with split keep pin .. .. .	103
Screw, fixing .. .. .	39		
Striker .. .. .	40	<b>Plunger, firing .. .. .</b>	104
Guide, bearing, striker spring .. .. .	41	Spring .. .. .	105
Sear, trigger .. .. .	42	Pin retaining .. .. .	106
Pin, axis .. .. .	43	Roller, .4 wide .. .. .	107
Screw, retaining .. .. .	44	Pin, axis, long .. .. .	108
Spring .. .. .	45	Roller, .25 wide .. .. .	109
Plunger .. .. .	46	Pin, axis, short .. .. .	110
Plate, retaining .. .. .	47		
Plunger, retaining .. .. .	48	<b>Lever, safety, left gun .. .. .</b>	111
Needle .. .. .	49	<b>Lever, safety, right gun .. .. .</b>	112
Nut .. .. .	50		
Bush, insulating .. .. .	51	<b>Levers, safety, left and right guns—</b>	
Washer, insulating .. .. .	52	Plunger with split keep pin .. .. .	113
Piece, contact .. .. .	53	Head .. .. .	114
Bush, insulating .. .. .	54	Spring .. .. .	115
Spring, striker .. .. .	55	Screw, retaining .. .. .	116
Spring, needle block .. .. .	56		
<b>Catch—</b>		<b>Bar, firing, with split keep pin .. .. .</b>	117
Lever .. .. .	57	Spring .. .. .	118
Pin, hinge .. .. .	58	Plunger .. .. .	119
Spring .. .. .	59		
Plug .. .. .	60		
Pin, retaining .. .. .	61		
Plunger .. .. .	62		



## APPENDIX II—continued

NOMENCLATURE	Index No.	NOMENCLATURE	Index No.
Lever, firing .. .. .	120	Lever, breech mechanism, left and right guns—	
Pin, axis .. .. .	121	Cap .. .. .	147
Roller .. .. .	122	Screw, check .. .. .	148
Pin, axis .. .. .	123	Spring, actuating, breech block .. .. .	149
Trigger .. .. .	124	Disc, bearing .. .. .	150
Screw, preserving .. .. .	124A	Cover .. .. .	151
Extractor .. .. .	125	Screw, securing .. .. .	152
Crank .. .. .	126	Lever, actuating, catch bar .. .. .	153
Block, sliding, crank .. .. .	127	Pin, axis .. .. .	154
Catch retaining breech block open—		Plunger, catch bar .. .. .	155
Left .. .. .	128	Pin, retaining .. .. .	156
Right .. .. .	129	Spring .. .. .	157
Spring .. .. .	(2 in No.) 130	Catch .. .. .	158
Pin, axis .. .. .	(2 in No.) 131	Spring .. .. .	159
Screw, fixing .. .. .	(2 in No.) 132	Guide, bearing .. .. .	160
Plunger .. .. .	(2 in No.) 133	Lever, locking, with split keep pin .. .. .	161
Pin, plunger .. .. .	(2 in No.) 134	Plunger, with split keep pin .. .. .	162
Shaft, actuating .. .. .	135	Spring .. .. .	163
Collar .. .. .	136	Head .. .. .	164
Sleeve .. .. .	137	Nut .. .. .	165
Screw, locking, with split keep pin .. .. .	138	Rack .. .. .	166
Lever, actuating, shaft, with split keep pin .. .. .	139	Bracket, stop, B.M. lever .. .. .	167
Pinion, rack, with flange and 2 screwed rivets .. .. .	140	Screw, fixing .. .. .	(2 in No.) 168
Lever, breech mechanism, left gun—		Plate, locking .. .. .	(2 in No.) 169
Body, with bush with 2 check screws and split keep pin .. .. .	141	Screw, fixing .. .. .	(2 in No.) 170
Guide .. .. .	141A	Plunger, releasing, B.M. lever catch .. .. .	171
Screw, securing—		Sleeve, with 2 split keep pins .. .. .	172
Long .. .. .	(3 in No.) 141B	Collar .. .. .	177
Short .. .. .	(3 in No.) 141B	Spring .. .. .	173
Nipple, lubricator, Enot's Fig. 1 .. .. .	(2 in No.) 142	Link .. .. .	178
Bar, catch .. .. .	143	Stud, axis, B.M. lever latch with split keep pin .. .. .	179
Lever, breech mechanism, right gun—		Nut .. .. .	180
Body, with bush with 2 check screws and split keep pin .. .. .	144	Screw, check .. .. .	181
Guide .. .. .	144A	Screw, preserving .. .. .	182
Screw, securing—		Screw, check .. .. .	183
Long .. .. .	(3 in No.) 144B	Latch, B.M. lever, left gun .. .. .	184
Short .. .. .	(3 in No.) 144B	Latch, B.M. lever, right gun .. .. .	185
Nipple, lubricator, Enot's Fig. 1 .. .. .	(2 in No.) 145	Handle, loading .. .. .	174
Bar, catch .. .. .	146	Screw, fixing, long .. .. .	175
		Screw, fixing, short .. .. .	(3 in No.) 176
		Rod, assembling rack .. .. .	
		Wrenches, breech mechanism—	
		No. 298 .. .. .	
		No. 299 .. .. .	
		No. 300 .. .. .	
		No. 302 .. .. .	
		No. 303 .. .. .	
		Tommy Nos. 302, 303, B.M. wrenches .. .. .	

See following pages for drawings of these component parts.



## APPENDIX III.

## LIST OF GUN MOUNTING SPARE PARTS TOOLS AND ACCESSORIES

"A" spares denote spare parts per mounting.

"C" spares denote spare parts per ship.

"D" spares denote base spares stored at Dockyards, Repair Establishments, etc.

Drawing No.	Item No.	Articles	"A"	"C"	"D"
<b>BEARINGS, BALL AND ROLLER</b>					
<b>Elevating Gear</b>					
<i>Brit. Stds. Inst. Ref. Symbol.</i>					
N.5182A	5	Thrust Bearing for Worm Shaft .. .. .	D.S.H. 1½	—	1
"	3	Ball Bearing for Worm Shaft .. .. .	B.R.M. 2	—	1
"	4	Ball Bearing for Worm Shaft .. .. .	B.R.M. 1½	—	1
"	6	Ball Bearing for Worm Shaft and Bevel Wheel Shaft ..	B.R.L. 1½	—	2
"	12	Ball Bearing for Bevel Wheel Shaft .. .. .	B.R.L. 1½	—	1
N.5177	6	Roller Bearing for Pinion Shaft .. .. .	R.R.L. 3½	—	1
"	7	Roller Bearing for Pinion Shaft .. .. .	R.R.L. 3	—	1
"	15	Ball Bearing for Pinion Shaft .. .. .	B.R.M. 4½	—	1
N.5183	3	Ball Bearing for Support Bracket .. .. .	B.R.L. 1½	—	2
<b>Training Gear</b>					
N.5149	4	Roller Bearing for Pinion Shaft .. .. .	R.R.L. 2	—	1
"	7	Roller Bearing for Pinion Shaft .. .. .	R.R.L. 3½	—	2
"	8	Thrust Bearing for Pinion Shaft .. .. .	—	—	2
N.5147	12	Ball Bearing for Worm Shaft .. .. .	B.R.M. 1½	—	2
"	15	Thrust Bearing for Worm Shaft .. .. .	S.R.H.—B1½	—	2
N.5150	6	Ball Bearing for Worm Shaft .. .. .	—	—	1
"	7	Ball Bearing for Intermediate Bevel Wheel Shaft ..	—	—	1
N.5152	4	Ball Bearing for Intermediate and Bevel Wheel Shaft ..	—	—	2
"	5	Ball Bearing for Bevel Wheel Shaft .. .. .	—	—	1
N.5154	3	Ball Bearing for Handle Spindle .. .. .	B.R.L. 1½	—	2
<b>Trunnions</b>					
N.5129	7	Roller Bearings for Trunnion Pins and Keeps ..	—	—	2
N.5138	2	Thrust Bearing for Trunnions .. .. .	—	—	2
<b>Drives to Elevation and Training Receivers</b>					
N.10913	7	} Ball Bearings .. .. .	B.R.L. 1½	—	16
N.10916	1				
N.10920	11				
N.10921	5				
N.10916	4	Ball Bearing .. .. .	B.R.L. 1	—	1
N.10915	4	Ball Bearing .. .. .	B.R.L. 1½	—	1
<b>Centre Pivot Bearing Complete, comprising—</b>					
N.10825	3	Inner Roller Race Bush .. .. .	—	—	1
"	2	Outer Roller Race Bush .. .. .	—	—	1
"	4	Retaining Ring for Roller Cage .. .. .	—	—	1
"	5	Lower Roller Cage .. .. .	—	—	1
"	6	Upper Roller Cage .. .. .	—	—	1
"	8	Distance Piece for Upper and Lower Roller Cage ..	—	—	8
"	9	Nuts for Distance Piece .. .. .	—	—	8
"	10	375 diameter countersunk Screws for Retaining Ring ..	—	—	8
"	1	Rollers .. .. .	—	—	40
<b>Cupleathers</b>					
N.5172	12	Cupleather for Recoil Cylinder .. .. .	2	—	—
N.5161	10	Cupleather for Recuperator Cylinder .. .. .	4	—	—
N.5167	7	Cupleather for Intensifier Piston .. .. .	4	—	—
"	11	Cupleather for Intensifier Stuffing Box .. .. .	2	—	—
<b>Trunnion Bearings</b>					
N.5130	8	Adjusting Washer (to accompany the set of Belleville Washers shown under Springs) .. .. .	—	2	—



## APPENDIX III—continued

Drawing No.	Item No.	Articles	"A"	"C"	"D"
<b>ELEVATING GEAR</b>					
<b>Set of Friction Discs, comprising—</b>					
N 5179	2	Friction Discs, Steel .. .. .	—	—	8
"	3	Friction Discs, Gunmetal .. .. .	—	—	8
"	6	Adjusting Washers (to accompany the set of Belleville Washers shown under Springs) .. .. .	—	1	—
<b>Firing Circuits</b>					
Firing Cables with Special Fittings only .. .. .					
Interceptor H.A. Mark IV, complete right-hand .. .. .					
Interceptor H.A. Mark IV, complete left-hand .. .. .					
<b>Joint Rings</b>					
N.5172	4	Joint Ring for Recoil Cylinder (Copper) .. .. .	2	—	—
"	21	Joint Ring for Recuperator Cylinder Air Valve (White metal) .. .. .	2	—	—
N.2171	14	Joint Ring for Recuperator Cylinder Drain Valve (White metal) .. .. .	2	—	—
N.5167	8	Joint Ring for Intensifier (White metal) .. .. .	2	—	—
<b>Recoil Cylinder</b>					
N.5172	14, 19 & 20	Air Valve .. .. .	1	—	—
"	16	Drain Plug .. .. .	—	1	—
N.5173	2, 5 & 8	Control Rod with Nut and Pin for Ships with Mark XVI Guns .. .. .	—	1	—
"	6 & 7	Control Shuttle Valve with Bearing Rings .. .. .	—	1	—
<b>PISTON COMPLETE, COMPRISING—</b>					
"	1 & 4	Piston Rod with 3 Bearing Rings .. .. .	—	—	2
"	9	Split Pin for Piston Rod Nut .. .. .	—	—	2
"	11	Air Cock for Piston Rod .. .. .	—	—	2
"	3, 12, 13 & 14	Recoil Control Ring with Locking Plates etc. .. .. .	—	—	2
N.5172	3	Nut for Piston Rod .. .. .	—	—	2
"	2 & 23	Collar with Set Screw for Piston Rod .. .. .	—	—	2
<b>Recuperator Cylinder</b>					
N.5161	14	Drain Valve .. .. .	1	—	—
N.5162	6, 7 & 8	Ram for Recuperator with Nut and Split Pin .. .. .	—	—	2
"	4, 5, 9 & 44	Tie Rods with Nuts and Split Pin complete .. .. .	—	—	2
N.5168	—	Adaptor to enable Flexible Hose with 1½-in. Female Connection to be used on existing 1½-in. Male Connection on Mounting when charging Recuperators .. .. .	—	1	—
—	—	Pressure Gauge, Patt. No. 2513 or 4667. (Dials to be marked "4-in. H.A. Twin XIX and 4-in. H.A. XX Mountings" and red line marked at 970 lbs./sq. in.) .. .. .	—	2	—
N.10858	9, 10, 11 & 12	Adaptor for Pressure Gauge complete with Joint Ring .. .. .	—	2	—
<b>Semi-Automatic Gear</b>					
N.22128	1	Cam actuating Breech Mechanism, Left .. .. .	—	1	—
"	2	Cam actuating Breech Mechanism, Right .. .. .	—	1	—
N.5205	3, 4 & 5	Link actuating Breech Mechanism, complete with Bushes and Pins .. .. .	—	1	—
N.5202	1, 2, 3, 6 & 7	Crank Arm modified to N.22193/3, complete with Bush, Washer (bronze 2.0 diameter) and Screws .. .. .	—	1	—
N.22128	3, 4 & 5	Friction Washer, Roller and Bush .. .. .	—	—	1
N.5202	8	Plunger, Crank Arm .. .. .	—	—	1
"	10	Spindle, Buffer, Crank Arm .. .. .	—	—	1
"	11	Bush securing Buffer .. .. .	—	—	1
"	13	Nut securing Buffer Spindle .. .. .	—	—	1
N.22128	4 & 5	Roller and Bush .. .. .	1	—	—
<b>Semi-Automatic Gear—Reduced Charges</b>					
N.5202	3*	Screw fixing 5/N.22413 .. .. .	2	—	—
"	6*	Washer for 4/N.22128 .. .. .	2	—	—
"	7*	Screw securing 6/N.5202 .. .. .	2	—	—
"	18*	Enots Grease Nipple .. .. .	2	—	—



## APPENDIX III—continued

Drawing No.	Item No.	Articles	"A"	"C"	"D"
<b>PISTON COMPLETE, COMPRISING—</b>					
<b>Semi-Automatic Gear—Reduced Charges—continued</b>					
N.22128	3*	Friction Washer for Roller .. .. .	2	—	—
"	4*	Roller .. .. .	2	—	—
"	5*	Bush for Roller .. .. .	2	—	—
N.22413	1	Cam, Left-hand—short recoil .. .. .	1	—	—
"	2	Cam, Right-hand—short recoil .. .. .	1	—	—
"	3*	Crank Arm, Left-hand—short recoil .. .. .	1	—	—
"	4*	Crank Arm, Right-hand—short recoil .. .. .	1	—	—
"	5*	Bush for 3 and 4/N.22413 .. .. .	2	—	—
N.10953	—	Range Dials—reduced charge, 1 set (3 dials) .. .. . (Items marked thus * to be delivered assembled.)	1	—	—
<b>Sighting and Sight-Testing Gear</b>					
—	—	Set of Sights complete with Dials (to suit Mark XVI* guns) .. .. .	—	—	1
—	—	Cables with special End Connections for Night Sight and Illumination .. .. .	—	1 set	—
N.10951	—	Bore Telescope Holder, Patt. UX .. .. .	—	1	—
—	—	Bore Telescope Holder, Patt. UX (for ships of new construction) .. .. .	—	2	—
N.9743	—	Dummy Telescope for Clinometer .. .. .	—	1	—
<b>Springs</b>					
N.5130	9	Belleville Washer for Trunnion Bearing .. .. .	—	4	—
N.5182A	18	Spring for Firing Rod .. .. .	—	1	—
N.5178	4	Spring for Elevation and Depression Stops .. .. .	—	2	—
N.5168	6	Spring, Valve Adaptor, Recuperator-charging .. .. .	—	2	—
N.10915	3	Spring, Drive to Training Receiver .. .. .	—	1	—
N.10912	10	Spring, Drive to Elevator Receiver .. .. .	—	1	—
N.5148	5	Belleville Washer for Training Worm Gear .. .. .	—	3	—
N.5179	7	Belleville Washer for Elevating Worm Gear .. .. .	—	3	—
N.10884	13	Spring for Cam Roller Shaft .. .. .	—	2	—
N.5203	4	Spring, Catch Change-over Lever, S.A. Gear .. .. .	—	2	—
N.5202	9	Spring, Crank Arm Plunger, S.A. Gear .. .. .	—	2	—
"	12	Spring for Buffer, S.A. Gear .. .. .	—	2	—
N.11466	7	Spring for Plunger Contact Interceptor .. .. .	4	—	—
<b>Tools</b>					
N.5241	1	Spanner for Training Roller Spindle .. .. .	—	1	—
"	2	Lever for Training Roller Spindle. Spanner .. .. .	—	1	—
"	3 & 6	Spanner for Training Pinion Shaft Nut .. .. .	—	1	—
"	4	Spanner for Training Worm Shaft. Adjusting Bush .. .. .	—	1	—
"	5	Spanner for Training Pinion Upper Gland Nut .. .. .	—	1	—
"	7	Spanner for Recuperator Cylinder Gland Ring .. .. .	—	1	—
"	8	Spanner for Training Pinion Shaft Lower Gland Ring .. .. .	—	1	—
"	9	Spanner for Recuperator Cylinder Retaining Nut .. .. .	—	1	—
"	10	Spanner for Intensifier Outer Gland Ring .. .. .	—	1	—
"	11	Lever for Training Pinion Shaft Lower Gland Ring Spanner .. .. .	—	1	—
"	12	Lever for Intensifier Inner Gland Ring Spanner .. .. .	—	1	—
"	13	Spanner for Intensifier Inner Gland Ring .. .. .	—	1	—
N.10930	1	Spanner for Intensifier Piston Nut .. .. .	—	1	—
"	2	Spanner for Recoil Cylinder Inner Gland Nut .. .. .	—	1	—
"	3	Spanner for Recoil Cylinder Outer Gland Nut .. .. .	—	1	—
"	4	Spanner for Firing Gear Push Rod Bushes .. .. .	—	1	—
"	5	Spanner for Recoil Cylinder Securing Nut .. .. .	—	1	—
"	6	Spanner for Recoil Cylinder Control Rod Retaining Nut .. .. .	—	1	—
"	7	Spanner for Recoil Cylinder Control Ring .. .. .	—	1	—
"	8	Spanner for Elevation Receiver Drive Gear Bracket Retaining Ring, and Training and Bearing Receiver Drive Pinion Bracket Retaining Ring .. .. .	—	1	—
"	9 & 10	Spanner for Sighting Gear Elevation Drive Shaft Retaining Ring .. .. .	—	1	—
N.5243	1	Spanner for Elevating Pinion Shaft Bracket Bearing Securing Ring .. .. .	—	1	—
"	2	Spanner for Elevating Worm Wheel Bracket Bearing Securing Ring .. .. .	—	1	—
"	3	Extractor for Elevating and Training Gear Friction Plates .. .. .	—	2	—
"	4	Spanner for Elevating Pinion Shaft Bearing Securing Rings .. .. .	—	1	—
"	5	Spanner for Elevating Bevel Gear Box Bearing Retaining Ring .. .. .	—	1	—
"	6	Extractor for Recoil and Recuperator Cylinder Gland Rings .. .. .	—	2	—
"	7	Spanner for Trunnion Bearing Adjusting Screw Bush .. .. .	—	1	—
"	8	Screw Driver for General Purposes .. .. .	—	1	—
"	9	Extractor for Intensifier Gland Rings .. .. .	—	2	—
"	10	Extractor for Elevating and Training Worm Wheels .. .. .	—	2	—
"	11	Screwdriver for Centre Pivot Roller Cage Nuts .. .. .	—	1	—
"	12	Spanner for Sighting Gear Range Worm Shaft Lock Nuts .. .. .	—	2	—



## APPENDIX III—continued

Drawing No.	Item No.	Articles	"A"	"C"	"D"
<b>PISTON COMPLETE, COMPRISING—</b>					
<b>Tools—continued</b>					
N.11613	1	Spanner for Star Shell Spirit Level Bracket Bolt .. .. .	—	2	—
"	2	Spanner for Sighting Gear Deflection Screw and Stop Gear Spindle Nuts .. .. .	—	2	—
"	3	Spanner for Sighting Gear Deflection Shaft Nuts .. .. .	—	2	—
"	4	Spanner for Sighting Gear Range Dial Spiral Gear and Deflection Dial Worm Wheel Nuts .. .. .	—	2	—
"	5	Spanner for Sighting Gear Deflection Worm Wheel Nuts .. .. .	—	2	—
"	6	Spanner for Intensifier Air, and Liquid Charging Valve, Spindles and Plugs .. .. .	—	1	—
"	7	Spanner for Sighting Gear Cross Connection Shaft Nuts .. .. .	—	2	—
"	8	Spanner for Elevating Pinion Shaft Nuts .. .. .	—	1	—
"	9	Lever for Elevating Pinion Shaft Nut Spanner .. .. .	—	1	—
N.11617	1	Spanner for Balance Weight Plugs Sighting Gear .. .. .	—	1	—
"	2	Spanner for Gun Elevating Drive Shaft Nut, Sighting Gear .. .. .	—	1	—
"	3	Spanner for Range Worm Shaft Collar Nuts Sighting Gear .. .. .	—	1	—
"	4	Spanner for Training Worm Gear Box Securing Bolts .. .. .	—	1	—
"	5	Screwdriver for Sighting Gear, Cover Screws .. .. .	—	1	—
"	6	Lever for Training Worm Gear Box Securing Bolt Spanner .. .. .	—	1	—
N.11614	1	$\frac{1}{2}$ -in. and $\frac{3}{4}$ -in. Standard Spanner .. .. .	—	1	—
"	2	$\frac{3}{8}$ -in. and $\frac{1}{2}$ -in. Standard Spanner .. .. .	—	1	—
"	3	$\frac{1}{2}$ -in. and $\frac{3}{4}$ -in. Standard Spanner .. .. .	—	1	—
"	4	$\frac{3}{4}$ -in. Standard Spanner .. .. .	—	1	—
"	5	$\frac{7}{8}$ -in. Standard Spanner .. .. .	—	1	—
"	6	1-in. Standard Spanner .. .. .	—	1	—
"	7	1 $\frac{1}{8}$ -in. Standard Spanner .. .. .	—	1	—
"	8	1 $\frac{1}{4}$ -in. Standard Spanner .. .. .	—	1	—
"	9	1 $\frac{3}{8}$ -in. Standard Spanner .. .. .	—	1	—
"	10	1 $\frac{1}{2}$ -in. Standard Spanner .. .. .	—	1	—
"	11	1 $\frac{3}{4}$ -in. Standard Spanner .. .. .	—	1	—
"	12	2-in. Standard Spanner .. .. .	—	1	—
"	13	2 $\frac{1}{2}$ -in. Standard Spanner .. .. .	—	1	—
"	14	2 $\frac{3}{4}$ -in. Standard Spanner .. .. .	—	1	—
"	15	3-in. Standard Spanner .. .. .	—	1	—
<b>Cup-leather Dies, Chucks</b>					
N.11615	1, 2 & 3	Ring Dies for Recuperator Cylinder, Gland Cup Leather .. .. .	—	1	—
"	4, 5 & 6	Ring Dies for Recoil Cylinder, Gland Cup Leather .. .. .	—	1 set	—
"	7, 8 & 9	Ring Dies for Intensifier Piston Cup Leather .. .. .	—	1 set	—
"	10, 11 & 12	Ring Dies for Intensifier Gland Cup Leather .. .. .	—	1 set	—
"	13	Chuck for Cup Leather .. .. .	—	1	—
"	14, 15, 16 & 17	Press for manufacture of Cup Leathers .. .. .	—	1 set	—
"	18	Turning Tool for Cup Leather .. .. .	—	1	—
N.10832	—	Hauling Back Gear .. .. .	—	1 set	—
N.10906	—	Charging Pump for Intensifier .. .. .	—	1	—
	—	Enots Grease Gun (Admiralty Pattern 4130) .. .. .	—	1	—
<b>TRAINING GEAR</b>					
<b>Set of Friction Discs, comprising—</b>					
N.5148	3	Friction Discs, Steel .. .. .	—	—	8
"	4	Friction Discs, Gunmetal .. .. .	—	—	8
"	6	Distance Washer (to accompany the set of Belleville Washers shown under Springs) .. .. .	—	1	—
<b>Voice Pipe</b>					
N.10838	1, 3, 17, 18 & 24	Voice Pipe complete with Ferrule and Coupling Nut, Flange and Rivets .. .. .	—	—	1
"	2	Adaptor for Flexible Voice Pipe .. .. .	—	—	1
"	4 & 12	Cast Band for Voice Pipe complete with Set Screws .. .. .	—	—	1
"	7	Joint Ring for Adaptor Flexible Voice Pipe .. .. .	—	—	1
"	8	Joint Ring for Flange for Voice Pipe .. .. .	—	—	1
"	11 & 12	Dummy Adaptor complete with Set Screw .. .. .	—	—	1
"	13 & 14	Locking Ferrule complete with Pin .. .. .	—	—	2
"	19	Oval Link Chain for Dummy Adaptor .. .. .	—	—	1
"	20	Eyebolt securing Chain .. .. .	—	—	1
"	23	"S" Hook for Chain .. .. .	—	—	2

(NOTE.—The voice pipe details are for fitting if necessary to mountings not originally provided with a voice pipe.)



## APPENDIX IV

## DETAILS AND NUMBERS OF MODIFICATIONS TO MOUNTINGS

Serial numbers have been allocated to the modifications authorised to the 4-in., H.A. Twin, Mark XIX Mountings including the R.P. 50 series.

Details of future modifications with their modification numbers will be promulgated as amendments to this handbook.

P.526/51

*Register Nos of Mountings should be forwarded to Admiralty as each modification is completed*  
 NOTE.—The letters "P" or "RP" below the modification number indicate that the modifications are applicable to PLAIN Mountings or RP series Mountings respectively. All other modifications are applicable to both plain and RP series Mountings.

Authority	Description	Diagram	Category of modification	Supply of material	By whom to be done	Modification No.
C.A.F.O. 1063/37	<b>S.A. GEAR</b> : Mountings Nos. 1 to 9, 16 to 19 and 51 to be modified as shown on diagram.	C.A.F.O. Diagram 43/37	—	—	Ship's staff and dockyard	1
A.F.Os. 2105/37, 2274/37, 363/39 C.A.F.O. 262/38	<b>S.A. GEAR</b> : Fit modified cams and rollers. <b>RECOIL PISTON RODS</b> : Type "B" to be fitted as standard. Existing type "A" to be modified to type "B". NOTE : A.F.Os. 2105/37 and 2274/37 and C.A.F.O. 262/38 were cancelled by A.F.O. 1311/39 and reinstated by A.F.O. 1451/39.	A.F.O. Diagram 111/37	A. and A.	On demand	Dockyards	2
C.A.F.O. 2605/37	Fit hydraulic <b>TRAINING BUFFER</b> and separate housing device, Drg. No. N.22382.	—	As. and As.	On demand	Dockyards	3 P
A.F.O. 928/38	<b>SIGHTING GEAR</b> : Fit instruction plate 6/N.5253.	—	Defect	—	Dockyards and ship's staff	4
A.F.O. 2160/38	<b>INTERCEPTOR</b> : Hexagonal headed bolt 4/N.10923 replaced by counter-sunk headed bolt 9/N.10923 and locking plate 12/N.11462 fitted.	A.F.O. Diagram 95/38	Defect	—	Ship's staff	5
C.A.F.O. 2493/38	<b>I BARRAGE SIGHTS</b> : To be fitted. <b>II SIGHT PORTS</b> : To be enlarged—New covers to be fitted to Drg. No. N.15307 is applicable to Mountings Reg. Nos. 2 to 13 inclusive and 15 to 77 inclusive. See also A.F.O. 1057/41 and A.F.O. 3693/43.	C.A.F.O. Diagram 86/38	As. and As.	On demand	Dockyards	6
A.F.O. 2700/38	<b>TRAINING BEARING RECEIVER DRIVES</b> : Gear box cover 4/N.10918 to be engraved.	A.F.O. Diagram 92/38	As. and As.	—	Dockyards	7
A.F.O. 1680/39	<b>RUN OUT CONTROL RODS</b> : Mountings Nos. 2, 3, 8 to 19, 24 to 31, 36 to 59, 64 to 97, 108 to 120 incl. Manufacturing error to be corrected.	A.F.O. 93/39	Defect	—	Ships and dockyards	8
A.F.O. 2697/39	<b>BALANCE WEIGHTS</b> to be fitted ...	A.F.O. Diagram 136/39	Defect	—	Dockyards	9
A.F.O. 2810/39	<b>PERCUSSION FIRING GEAR</b> length of palm lever reduced and palm piece modified. See also A.F.O. 3698/39.	A.F.O. Diagram 134/39	A. and A.	—	Dockyards	10
A.F.O. 2917/39	<b>LOADING LIGHTS</b> : Alternative position for loading light.	A.F.O. Diagram 153/39	Optional	—	—	11
A.F.O. 3698/39	<b>PERCUSSION FIRING GEAR</b> : To be fitted to mountings not already fitted (as enumerated).	Drgs. Nos. N.24303 and N.21805A	A. and A.	Supplied without demand	Dockyards	12



Authority	Description	Diagram	Category of modification	Supply of material	By whom to be done	Modification No.
C.A.F.O. 552/40	I. <b>BALANCE RING</b> : Modifications to facilitate the withdrawal of loose bands. II. <b>RECOIL CONTROL ROD</b> : Modifications to facilitate the withdrawal of loose bands I. Holes for removal of breech ring securing screws. II. Hexagon on end of control rod 2/N.5173 to be cut off and four 0.35-in. dia. holes drilled for spanner 3/N.5241. See also C.A.F.O. 850/39 and 994/39.	C.A.F.O. Diagram 83/40	A. and A.	—	I. Dockyards II. Ship's staff	13
A.F.O. 2368/40	<b>S.A. GEAR</b> : Holes drilled at section A A of brackets 1/N.10888 and 1/N.10889 to facilitate interchange of full and reduced charge cams, etc.	A.F.O. Diagram 153/40	—	—	Ship's staff	14
A.F.O. 2689/40	<b>INTERCEPTOR</b> : Engraving of "A" and "M" transposed. Wiring reversed.	—	—	—	Ship or dockyard	15
A.F.O. 3728/40	<b>PLATFORMS — NORMAL TYPE SHIELD MOUNTINGS ONLY</b> :	A.F.O. Diagram	A. and A.	To be demanded	Dockyards	16

Insert details of Modification No. 111:—

A.F.O. 2870/50	<b>METADYNE STARTERS MARK 7MV—</b> Remove the ammeter together with its associated wiring and mounting bracket from all Metadyne Starters Mark 7MV fitted on the above gun mountings. The remaining hole should be blanked off.	Drawing Nos. X2031766 X2031171	—	—	Ship's staff, Shore Establishments and Gunnery Equipment Depots	111
----------------	--	--------------------------------------	---	---	--	-----

(Amendment No. 29.)

G.4805/40	<b>S.A. GEAR</b> : Reduced charge cams 1 and 2/N.22413 cut away to enable cams to be fitted without running gun back.	—	—	—	Manufacture or dockyard with Admiralty approval	18
A.F.O.	<b>FITTING OF 670° TRAINING STOPS</b>	—	A. and A.	—	Dockyards	19

Page 57 (inserted by A.F.O. P.559/48).

Item, Modification No. 19P. Column 2. Add:—

"The pawl retaining catch to Drawing No. N.31365 must be fitted at the same time."

(G. 0620/50.—A.F.O. P.255/50.)

Page 57 (as inserted by A.F.O. P. 559/48). Modification No. 24. Second column. Add "Extended type shield mountings only."

(G. 04086/50.—A.F.O. P. 9/51.)

A.F.O. 1057/41	<b>BARRAGE SIGHTS</b> : Approved form of 200 knot barrage sight to be fitted. Drawings, Nos. N.30605, N.30606 and A. See also A.F.O. 3693/43 and C.A.F.O. 2493/38.	A.F.O. Diagram 113/41	—	—	Ships and dockyards	21
A.F.O. 2268/41	<b>BALANCE RING</b> : Engraving "Dismantle" to indicate dismounting position of breech ring.	A.F.O. Diagram 204/41	—	—	Ship's staff	22
A.F.O. 3602/41	<b>INTERCEPTOR</b> : Fitting steel stop piece, items 10 and 11/N.11463.	A.F.O. Diagram 337/41	—	—	Ship's staff	23
G.0736/41	<b>PLATFORMS</b> : Addition of drain holes to items 13 and 14/N.21805A (6 in No. x .75 dia.).	—	—	—	Manufacturer or dockyards with Admiralty approval	24
G.4906/41	<b>SIGHT PORT COVERS</b> : Drain holes added to item 4/N.22930.	—	—	—		25
G.01311/41	<b>RECOCKING TOOL</b> : Stowage position added, N.10834.	—	—	—		26



Authority	Description	Diagram	Category of modification	Supply of material	By whom to be done	Modification No.
A.F.O. 1911/42 A.F.O. 2241/42	<b>RECOIL CYLINDERS</b> : Instruction plate 2/N.5170A, modified re filling instructions.	—	—	—	Ship's staff	27
A.F.O. 2882/42	<b>CARRIAGE</b> : To fit additional stiffening to Drawing No. N.33221. See also N.5129, N.10816, N.10834. <b>SIGHT PINIONS</b> : Fit oversize pinions if necessary. See also A.F.O. 5425/44.	A.F.O. Diagrams 152/42 (1 and 2)	A. and A.	—	Dockyards and depot ships	28
A.F.O. 3375/42	<b>SHIELDS AND PLATFORMS—EXTENDED SHIELD TYPE MOUNTINGS ONLY</b> : Modifications to shield, platforms and balance weight for H.M. Ships "Cumberland", "Aurora", "Newcastle", "Sheffield", "Birmingham", "Glasgow", "Liverpool" and "Manchester" and for future manufacture as required to Drawing Nos. N.26843 and N.26843A.	A.F.O. Diagram 182/42 and Drawing GR.6008	A. and A.	On demand	Dockyards and repair establishments	29
A.F.O. 4116/42	<b>RECOIL CYLINDER RUSH</b> : Thrust diameter to be increased to 2 27/32 in. 400 c.c. (canceled) replaced by No. N.5173.	—	Defect	—	Ship's staff or depot ship's staff	30
A.F.O. 4868/42	<b>APRON PLATES</b> : To be fitted to the front of the shield.	A.F.O. Diagram 263/42	At first available opportunity	Plate to be demanded	Ship's staff	31
A.F.O. 5153/42	<b>SAFETY TRAINERS SIGHT</b> : Fitting of safety trainers sight to be discontinued. A.F.O. 1517/39 is cancelled.	—	—	—	—	32
A.F.O. 5551/42	<b>BLAST BAGS</b> : Existing blast bags to be replaced by modified type to Drawing No. N.34931 if and when the former are unsatisfactory or defective.	A.F.O. Diagram 301/42	—	—	Ship's staff, with assistance of dockyards if necessary	33
G.013476/42	<b>ELEVATING LIMIT SWITCH</b> : Operating gear spring box assembly modified, i.e. items 9, 11, 12, 14, 15, 16, 42 and 43 of original Drawing No. N.33055 cancelled and replaced by items 44 to 48 of N.33055.	—	—	—	Manufacturer or dockyards with Admiralty approval	34 R.P.
G.06049/42	<b>ELEVATING GEAR</b> : Thrust bearings 3 and 4/N.32454 added to hand worm shaft assembly.	—	—	—	Manufacturer or dockyards with Admiralty approval	35 R.P.
A.F.O. 38/43	<b>SIGHT PINION SHAFT</b> : Extension piece and elbow, etc. items 1 to 4/N.34342 to be fitted to lubricator in gear box 1/N.10937.	A.F.O. Diagram 2/43	—	—	Ships' staff	36
A.F.O. 2374/43	<b>SAFETY PERCUSSION FIRING GEAR</b> : Safety percussion gear to be fitted to Drawing No. N.34918 (Drawing Nos. N.10868 and N.10867 modified) NOT APPLICABLE TO MOUNTINGS FITTED WITH SAFETY FIRING SWITCH GEAR TO DRAWING No.47618 G.B.	A.F.O. Diagram 159/43(1-2)	A. and A.	—	Ship's staff with dockyards and depot ships	37
A.F.O. 3284/43	<b>TRUNNION BEARINGS</b> : Fit modified trunnion bearing assembly to Drawing Nos. N.22904 and N.30603. This order cancels A.F.Os. 2500/42 and 4052/41.	—	A. and A.	To be demanded	Dockyards	38
A.F.O. 3560/43	<b>SHIELD</b> : Access hole to be cut in shield for mountings fitted with F. Mark II Elevation receivers and/or Pattern No. 20 Training Receivers (small type modified) Drawing No. N.10815 and GR.6357.	A.F.O. Diagram 232/43	—	—	Ship's staff	39

*Cancelled and replaced by Modification No. 85-29/51*



Authority	Description	Diagram	Category of modification	Supply of material	By whom to be done	Modification No.
A.F.O. 3693/43	<b>BARRAGE SIGHTS : MOUNTINGS FITTED WITH TYPE F, MARK II ELEVATION RECEIVER :</b> Barrage sight on L.H. side to be repositioned to avoid wooding. Drawing No. N.30606A, GR.6358.	A.F.O. Diagram 240/43(1-2)	—	—	Ship's staff	40
A.F.O. 4436/43	<b>ELEVATING GEAR HAND POWER CLUTCH :</b> Additional lubrication to be provided. P.T. Drawing N.33038.	A.F.O. Diagram 284/43	—	—	Ship's staff	41 R.P.
G.010751/43	<b>HOUSING STOP :</b> Modification to make the stop standard for all types of mountings, i.e. items 1 to 4 N.22505 and items 8 and 9/ N.10835A modified item 13/N.22505 added.	—	—	—	Manufacturer or with Admiralty Approval	42
G.014630/42 April, 1943	<b>SAFETY FIRING SWITCH OPERATING GEAR :</b> To be fitted to all mountings for future manufacture to Drawing No. 47618GB. Necessitates modifications as shown on Drawings N.22904, N.30603, N.33221, N.10816, N.10834, N.33948*, N.33799*, N.34840* (* for RP mountings only). Note.—When this gear is fitted the palm lever interlock for percussion firing should also be fitted see A.F.O. 3638/45.	—	—	—	Manufacturer or with Admiralty Approval	43
July, 1943	<b>SLIPPING CLUTCHES :</b> Elevating and Training, items 33 and 34/ N.33028 added see Drawings N.33033 and N.33052.	—	—	—	Manufacturer or with Admiralty Approval	44 R.P.
October, 1943	<b>TRAINING LIMIT SWITCH GEAR :</b> Adjustable cams, items 9 and 10/ N.32471 modified.	—	—	—	Manufacturer or with Admiralty approval	45 R.P.
September, 1943	<b>TRAINING BASE :</b> Inspection hole at R.H. side of training base and cover added—N.10821A.	—	—	—	Manufacturer or with Admiralty approval	46 R.P.
G.03848/43	<b>JOYSTICK CONTROL COLUMN :</b> Support bracket N.34847 replaced by N.36167.	—	—	—	Manufacturer or with Admiralty approval	47 R.P.
December, 1943	<b>JOYSTICK HANDLE :</b> Handle of locking pin 7/N.34847 lengthened.	—	—	—	Manufacturer or with Admiralty approval	48 R.P.
G.016956/43	<b>ELEVATING GEAR :</b> Bearing assembly for worm wheel shaft (friction disc end) modified as shown in inset "Z" of Drawing No. N.33038.	—	—	—	Manufacturer or with Admiralty approval	49 R.P.
A.F.O. Page 59.	<b>SEMI PERMANENT STOP :</b> For use Modification No. 51. Delete and substitute in column 2 :—	A.F.O.	A. and A.	—	Ship's staff depot ships and	50 P.
	<b>LOCAL CONTROL OFFICERS SIGHT</b> —To be fitted in lieu of safety trainers sight. CANNOT BE CARRIED OUT ON MOUNTINGS WITH ROCKET FLARE LAUNCHERS AS FITTED TO DRAWING No. G.1840, i.e., unless the launchers are fitted as shown on Drawing No. G. 2287. Drawings Nos. N. 36078F, N. 36079F, N. 36080.		A. and A.	To be demanded	Ship's staff and dockyards	51

(G. 1898/53.—Amendment No. 25.)



Authority	Description	Diagram	Category of modification	Supply of material	By whom to be done	Modification No.
A.F.O. 3394/44	<b>SHIELD</b> : Holes to be cut in side of shield for access to gun driving motors and covers to be fitted— <i>Note.</i> —Both sides for R.P.50 Mountings. L.H. side only for R.P.51 and R.P.52 Mountings.	A.F.O. Diagram 198/44	—	—	Ship's staff	53 R.P.
A.F.O. 4742/44	<b>SIGHT TRUNNION BRACKET</b> : Additional grease nipple to be fitted at the bottom of the sight trunnion bracket cover R.H. side only. Drawing Nos. N.10938 and N.10935.	—	—	—	Ship's staff	54
A.F.O. 4004/44	<b>HAULING BACK GEAR</b> : Muzzle adaptor push, item 56/N.10932, to be made for use with guns with parallel muzzles.	A.F.O. Diagram 201/44	Defect	—	Ship's staff and dockyards	55
A.F.O. 5306/44	<b>RECEIVER DRIVES</b> : (Elevating and training). Modification to Vernier couplings.	A.F.O. Diagram 320/44	—	—	Ship's staff	56
A.F.O. 5425/44	<b>SIGHT AND ELEVATION RECEIVER DRIVE PINION</b> : Instructions for fitting and supply of oversize pinions in conjunction with A.F.O. 2882/42 (cancelling A.F.O. 5892/42).	—	—	To be demanded	—	57

Page 60 (as inserted by A.F.O. P. 559/48). Modification No. 58. Second column. Add "Normal type shield mountings only."

(G. 04086/50.—A.F.O. P. 9/51.)

G.08940/44	<b>SHIELD</b> : Handle 71/N.10815 added.	—	—	—	Manufacturer or Dockyard with Admiralty approval	59
G.7395/44	<b>SIGHT PORT COVER</b> : Rotherham lubricator added to hinges items 3/N.15307.	—	—	—	Manufacturer or Dockyard with Admiralty approval	60
G.04010/44	<b>ELEVATING HANDLES</b> : Locking pin, etc. items 25 to 33/N.10877 added for securing handles.	—	—	—	Manufacturer or Dockyard with Admiralty approval	61
G.02944/44	<b>BATTERY LUBRICATION</b> : Fitted to Drawing No. N.36182 for future manufacture.	—	—	—	Manufacturer or Dockyard with Admiralty approval	62
March, 1944 G.0497/43	<b>BLAST SCREEN GEARS</b> : Elevating and training cut-off cams modified— Drawing Nos. N.36098, N.36098A, N.34838, N.34849, N.36162, N.36162A.	—	—	—	Manufacturer or Dockyard with Admiralty approval	63 R.P.
August, 1944	<b>RESETTER BOX</b> : Elevating gear— Screwed plug 8/N.36166 lengthened and washer 14/N.36166 added to prevent oil leaking through. Coarse/Fine mountings only.	—	—	—	Manufacturer or Dockyard with Admiralty approval	64 R.P.
C.A.F.O. 1663/45	<b>LOUDSPEAKER FOR ARMAMENT BROADCAST SYSTEM</b> . Loudspeaker to be positioned inside the shield to Drawing No. N.39392.	C.A.F.O. Diagram 100/45	A. and A.	—	Ship's staff	65
A.F.O. 3175/45	<b>ELEVATING GEAR REDUCTION GEAR BOX</b> : Fit oil level plug at platform level and fit instruction plate. Items 17 to 22/N.32470 and 21 and 22/N.33051.	A.F.O. Diagram 220/45	Defect	—	Ship's staff	66 R.P.



Authority	Description	Diagram	Category of modification	Supply of material	By whom to be done	Modification No.
A.F.O. 3638/45	<b>PERCUSSION FIRING GEAR :</b> Fit interlock to palm lever Drawing Nos. N.30390, N.30391—ONLY APPLICABLE TO MOUNTINGS FITTED WITH SAFETY FIRING SWITCH OPERATING GEAR.	A.F.O. Diagram 246/45 (1 and 2)	A. and A.	—	Ship's staff and dockyards	67
A.F.O. 4890/45	<b>FRICTION DISC COUPLINGS :</b> Elevating and Training—Lever 15/N.33590 and step gauges, etc. items 30, 31 and 32/N.33028 to be made for checking the adjustment of the setting.	A.F.O. Diagram 322/45	—	—	Ship's staff	68 R.P.
A.F.O. 5067/45	<b>BRACKET FOR REMOVAL OF BREECH BLOCK :</b> Bracket to be made to facilitate the lowering of the breech block (13/N.5243).	A.F.O. Diagram 334/45	—	—	Ship's staff	69
G.2574/45	<b>RECUPERATOR GLAND NUT :</b> Nut item 3/N.5161 modified by reducing the leading dia. to 5.3-in. and increasing the length of same from 0.1-in. to 0.35-in.	—	—	—	Manufacturer or Dockyard with Admiralty approval	70
January. 1945	<b>CORRECTOR GEAR FOR FOLLOW-THROUGH TRANSMITTERS :</b> Access hole and items 19, 20, 21 and 22 Drawing No. N.37347 added.	—	—	—	Manufacturer or Dockyard with Admiralty approval	71 R.P.
A.F.O. 424/46	<b>BREECH WORKERS FIRING PUSH :</b> To be fitted to mountings with safety firing switch gear only (N.38967).	A.F.O. Diagram 18/46	A. and A.	To be demanded	Ship's staff	72
A.F.O. 6001/46	<b>CORRECTOR GEAR FOR FOLLOW-THROUGH TRANSMITTER :</b> Wiring connection and engraving on items 17, 18, 22 and 23 of N.37341 to be reversed.	—	Defect	—	Ship's staff	73 R.P.

Page 61 (as inserted by A.F.O. P. 559/48). Modification No. 74 R.P. Second column. Add "Coarse/ fine mountings only."

(G. 04086/50.—A.F.O. P. 9/51.)

A.F.O. 1044/47	<b>CRADLES OF CANADIAN MANUFACTURE :</b> To rectify improperly manufactured cradle lugs where necessary. Drawing No. N.5159A.	A.F.O. Diagram 39/47	Defect	—	Dockyards and Depot ships	75
A.F.O. 1516/47	<b>BREECH WORKERS LOADING PLATFORM :</b> To be fitted to PLAIN MOUNTINGS ONLY (Drawing No. GR.7261).	A.F.O. Diagram 60/47	A. and A.	—	Dockyards and depot ships	76 P
A.F.O. 1803/47	<b>HOUSING STOP BRACKET :</b> Stop piece to be fitted (items 14 and 15 N.22505 or 16 and 17 N.22505F).	A.F.O. Diagram 78/47	Defect	—	Ship's staff	77
A.F.O. 1804/47	<b>670° TRAINING STOP GEAR :</b> To fit warning and instruction	A.F.O. Diagram	Defect	—	Ship's staff	78 R.P.
A.F.O. 1337/49	Fitting of brass range strips for star shell control.	A.F.O. Diagram 47/49(1-3)	Defect	To be demanded	Ship's staff	81
A.F.O. 2969/49	Fitting of safety firing gear to Rocket Flame Launchers.	Relevant drawing Nos. N.4113, N.4114, D.E.E. 16152/R4	A. and A.	To be demanded	Dockyards	82
A.F.O. 2673/50	<b>SHIELD.</b> Cut two holes in top of shield for lifting slings and fit cover plates.	Relevant drawing No. N.10815	Defect	—	Dockyards and repair establishments stores.	83P
A.F.O. 2674/50	<b>LIFTING GEAR.</b> Lengthen sling attachment.	Relevant drawings No. N.33588	Defect	—	Dockyards and repair establishments stores.	84



(A.17)

Order No.	Description	Diagram No.	Category of modification	Supply of material	By whom to be done	Modification No.
A.F.O. 1130/50	<b>RECOIL CONTROL RING.</b> —Modified rings (2.25-in. dia.) item 16/N. 5173 to be fitted. This modification cancels and replaces modification No. 30. <b>INSTRUCTION PLATE</b> (1/N.5170A) for filling recoil cylinder, to be modified by the addition of the words "USE OIL O.M.13" after "REPLACE TANK PLUGS." <i>Note.</i> —Modification to the recoil control ring and the instruction plate must be carried out concurrently.	Drawing No. N.5173A  Drawing No. N.5170A	Defect	To be demanded	Ship's staff	85
A.F.O. 1872/50	<b>670° TRAINING STOP GEAR—GUARDS.</b> —Manufacture and fit extension to existing guards.	Drawing No. N.36093 Sheet 2	Defect	—	Ship's staff and dockyard	86 R.P.
A.F.O. 1872/50	<b>670° TRAINING STOP GEAR—TRAINING INDICATOR.</b> —Screwed spindle and nut 1/N.37337 to be replaced by separate items 28 and 29/N.37337 for replacements and future manufacture only.	Drawing No. N.37337	Defect	—	Ship's staff and dockyard	87 R.P.
A.F.O. 2280/50	<b>CRADLES.</b> —To rectify incorrectly machined cradles where necessary, i.e., sharp corners of less than 0.25-in. radius on the recoil piston rod lugs, to be built up by welding.	A.F.O. Diagram 71/50 Drawing No. N.5159A	Defect	—	Dockyards and G.E. Depots	88
A.F.O. 2984/50	<b>LUBRICATION.</b> —Non-standard nipples to be replaced by equivalent Admiralty Pattern (British Standard type) nipples. <i>Note.</i> —This order only applies to defective nipples.	—	—	—	Ship's staff	89

(G. 04086/50.—A.F.O. P. 9/51.)

Admiralty Letters G.5985/51 dated 1st July, 1952 and 10th October, 1952	<b>ROCKET FLARE LAUNCHERS.</b> —Fitting of Safety Firing Gear (Cam Rail modified to 47-in. Rad.)	Relevant drawings Nos. N.41413 N.49393 N.49394 D.E.E. 15152/R.5	A and A B.	To be demanded	Dockyards, repair establishments and stores	90
A.F.O. 585/52	<b>INTENSIFIERS.</b> —Fitting of Synthetic Rubber Seals	G.R.7643	Defect	To be demanded	Ship's staff with Dockyard assistance if required	91

(G. 5618/52.—Amendment No. 24.)



Order No.	Description	Diagram No.	Category of modification	Supply of material	By whom to be done	Modification No.
A.F.O. 554/53	<b>TRAINING HAND-POWER CLUTCH.</b> —Cover for sliding clutch and clutch pin coupling modified.	A.F.O. Diagram 10/53 Drawing	Defect	—	Ship's staff with Dockyard assistance	92 R.P.
Page 63. After entry relating to Modification No. 93 R.P. insert :—						
A.F.O. 2786/53	<b>PALM LEVER INTERLOCK.</b> —Thumb lever to be modified. ONLY APPLICABLE TO MOUNTINGS WITH SAFETY FIRING SWITCH GEAR. (Handbook Plate 24A)	A.F.O. Diagram 45/53 Drawings Nos. N.39390, N.39390A	Defect	—	Ship's staff with dockyard assistance	94
A.F.O. 362/54	<b>SAFETY FIRING SWITCH GEAR.</b> (Handbook Plate 24A).—Fit additional lubricator and 7 in No. flexible pipes to inaccessible lubrication points.  Stronger spring to be fitted if found necessary.	A.F.O. Diagram 4/54 (1) and (2) Drawings Nos. N.36182, N.36182A, 71204G.B, 71204G.B.	Defect	Flexible pipes to be demanded  To be demanded	Ship's staff with dockyard assistance  —	95  95A
Admiralty Letter G.03695/51 dated 26th March, 1952	<b>SHIELD.</b> —Stiffening bracket to be fitted for 900 M.V. set.	Drawings Nos. N.10815, N.51465	A. and A. A. and B.	—	Dockyard	96
A.F.O. 3113/53	<b>CARRIAGE.</b> —Gusset plate 7/N10834 to be cut away if necessary to avoid foul.	Drawing No. N.10834	Defect	—	Ships' staff and Depots	97
A.F.O. 3570/53	<b>REAR CANVAS COVER.</b> —Securing rail to be fitted at base of mounting.	A.F.O. Diagram 59/53	Defect	—	Ships' staff with dockyard assistance	98
✓ G.5020/55	<b>PARTITION SHIELD.</b> —To be fitted between guns. Bracket for loading lamps to be modified.	Drawing Nos. N.52442 revc. N.10898 revc.	A. and A. "S.S." for cruisers "A" for others	To be demanded	Ships' staff Depot ships and Dockyards as appropriate	99
(Amendment No. 27.)						
	over guns and inspection cover and replace them with light metal guard and hexagon nuts. Fit light metal guard over sight and receiver pinions. Fit metal strip on centre tee bar between guns.	D.N.O. 9626, D.N.O. 8975 See Diagram 24/55 (1) and (2)			assistance if necessary	(427)
Admiralty Letter G.09014/51 dated 9th April, 1952	<b>SHIELD.</b> —Fit bosses for theodolite platform.	Drawings Nos. N.10815, D.N.O. 8558	A. and A. A	—	Dockyard	101
✓ G.4444/55	<b>PORTABLE PLATE BETWEEN PLATFORMS.</b> —Fitted to R.P.51 and R.P.52 mountings mounted on raised platforms.	Drawing Nos. DEV. MED 59531/R DEV. MED 59207	A. and A. Classification "A"	—	Dockyard	102 R.P.
(Amendment No. 27.)						
G.0044/51 dated 6th December, 1951	certain BLACK SWAN class ships.	G.2351, G.2347				(427)

(G. 6391/53.—Amendment No. 26.)

(Previous amendment No. 25.—A.F.O. P.274/53.)



Order No.	Description	Diagram No.	Category of modification	Supply of material	By whom to be done	Modification No.
A.F.O. 3048/54	<b>BARREL EXCHANGE GEAR.</b> —Diameter of muzzle cap to be reduced from 7-25-in. to 6-6-in.	Drawing No. G.1391 Sheet 5	Defect	—	Ships' staff, Dockyards and Depots	104
A.F.O. 2906/54	<b>SEMI-AUTOMATIC GEAR.</b> —Three drain holes to be drilled in the Buffer Securing Bush.	A.F.O. Diagram 47/54 Drawing No. N.52777	Defect	—	Ships' staff Depot ships and Authorities concerned	105
G.385/55	<b>CABLE GUARDS.</b> —Existing Guards to be replaced by new design to prevent foul with gun at maximum elevation.	Drawing No. N.48586 Rev'd.	Defect	To be demanded	Ships' staff with Dockyard assistance	106 R.P.
G.2885/54	Fitting of <b>LOADERS FIRING PUSHES</b> , On/Off Switch and Rewiring Firing Circuit.	D.E.E. 26207	A. and A.	—	Dockyard	107
G.2298/53	<b>ROCKET FLARE LAUNCHERS</b> — <i>for Type 15 Frigates only</i> —Additional Safety Firing Switch.	Drawing No. N.52443 <del>DEC 25/54</del>	A. and A.	—	Dockyard	108
G.2177/56	<b>SHIELD.</b> —(a) To bolt light metal plates to sides of Shield; (b) Fitting of Canvas Hood. (c) To decrease the end radius of the top Canvas Curtain Rail.	Drawings Nos. N.52091 N.54172 N.54173	A. and A.	—	Dockyards	109
<b>CANCELLED</b>						
G.9476/57 A.F.O. 3152/57	<b>RECOIL CYLINDER.</b> —To rebores Recoil Cylinder to remove score marks. <i>Note.</i> — <b>ONLY</b> to be carried out when cylinder is so scored that it requires re boring.	Drawing No. N.54045 (Rev.) Items 6-13 only	Defect	—	Dockyards and Establishments concerned	110

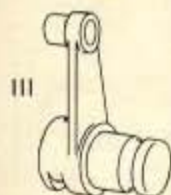
(Amendment No. 27.)

A.F.O. 2670/59	<b>METADYNE STARTERS MARK 7MV</b> —Remove the ammeter together with its associated wiring and mounting bracket from all Metadyne Starters Mark 7MV fitted on the above gun mountings. The remaining hole should be blanked off.	Drawing Nos. X2031756 X2031171	—	—	Ship's staff, Shore Establishments and Gunnery Equipment Depots	111
-------------------	---	--------------------------------------	---	---	--	-----

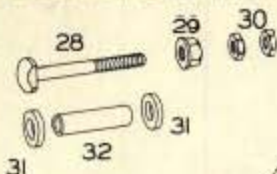
(Amendment No. 29.)



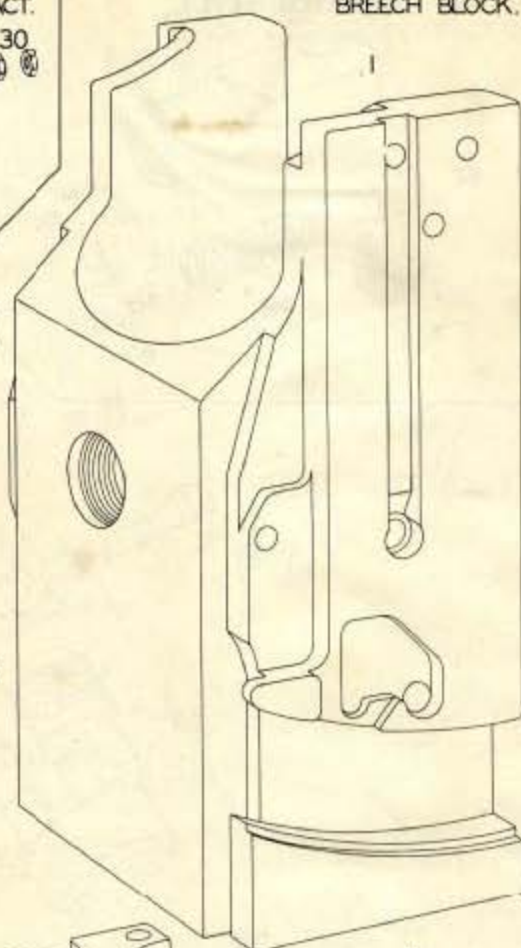
SAFETY LEVER  
LEFT GUN.



BREECH RING CONTACT.

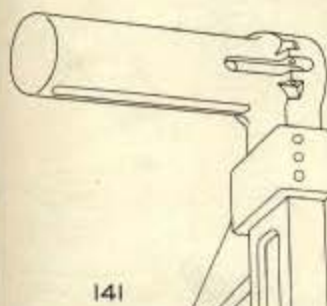
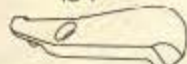


BREECH BLOCK.

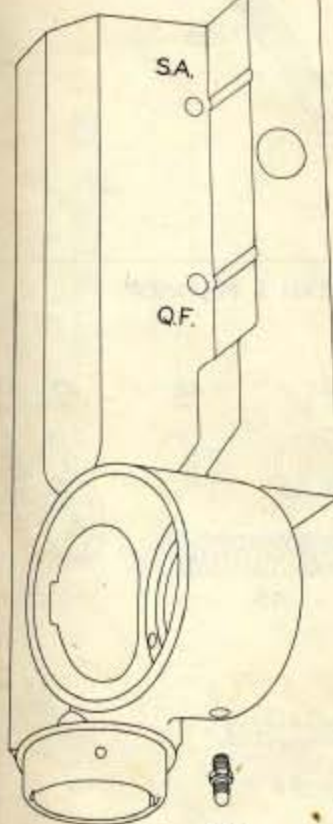


BM. LEVER, LATCH  
& CATCH BAR  
LEFT GUN.

184



141

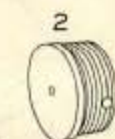
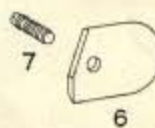


SA.

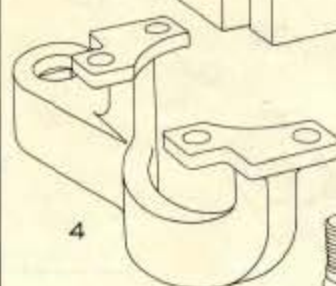
Q.F.

142

143



3



4



9

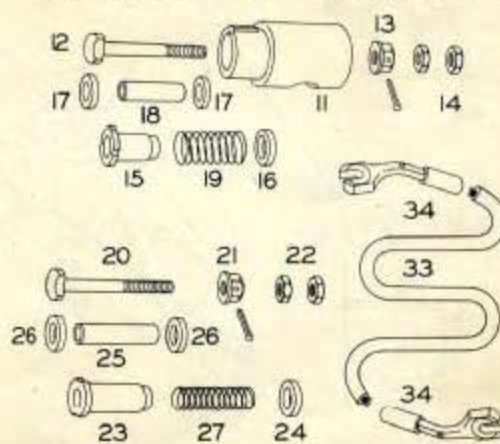


8



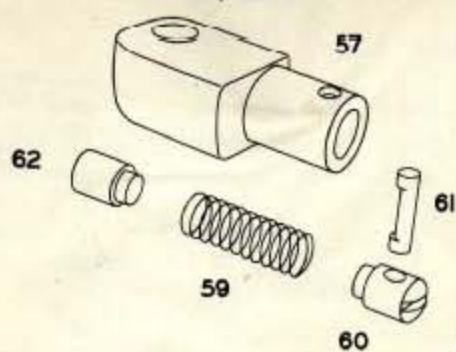
8A

INNER & OUTER BREECH BLOCK CONTACTS.

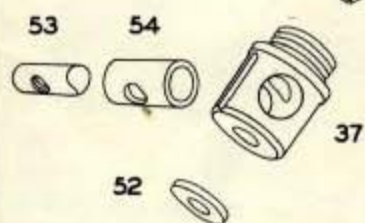
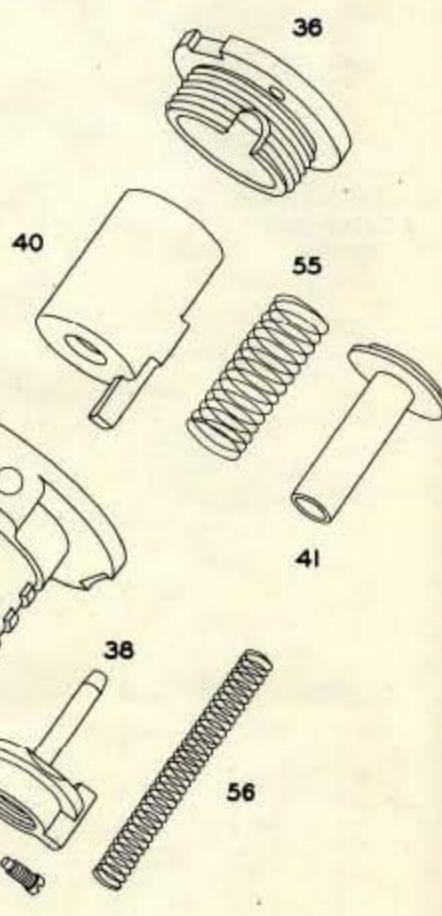




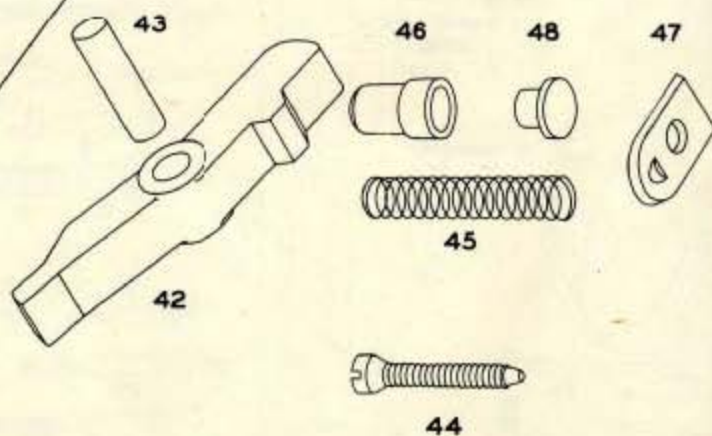
# CATCH, LEVER.



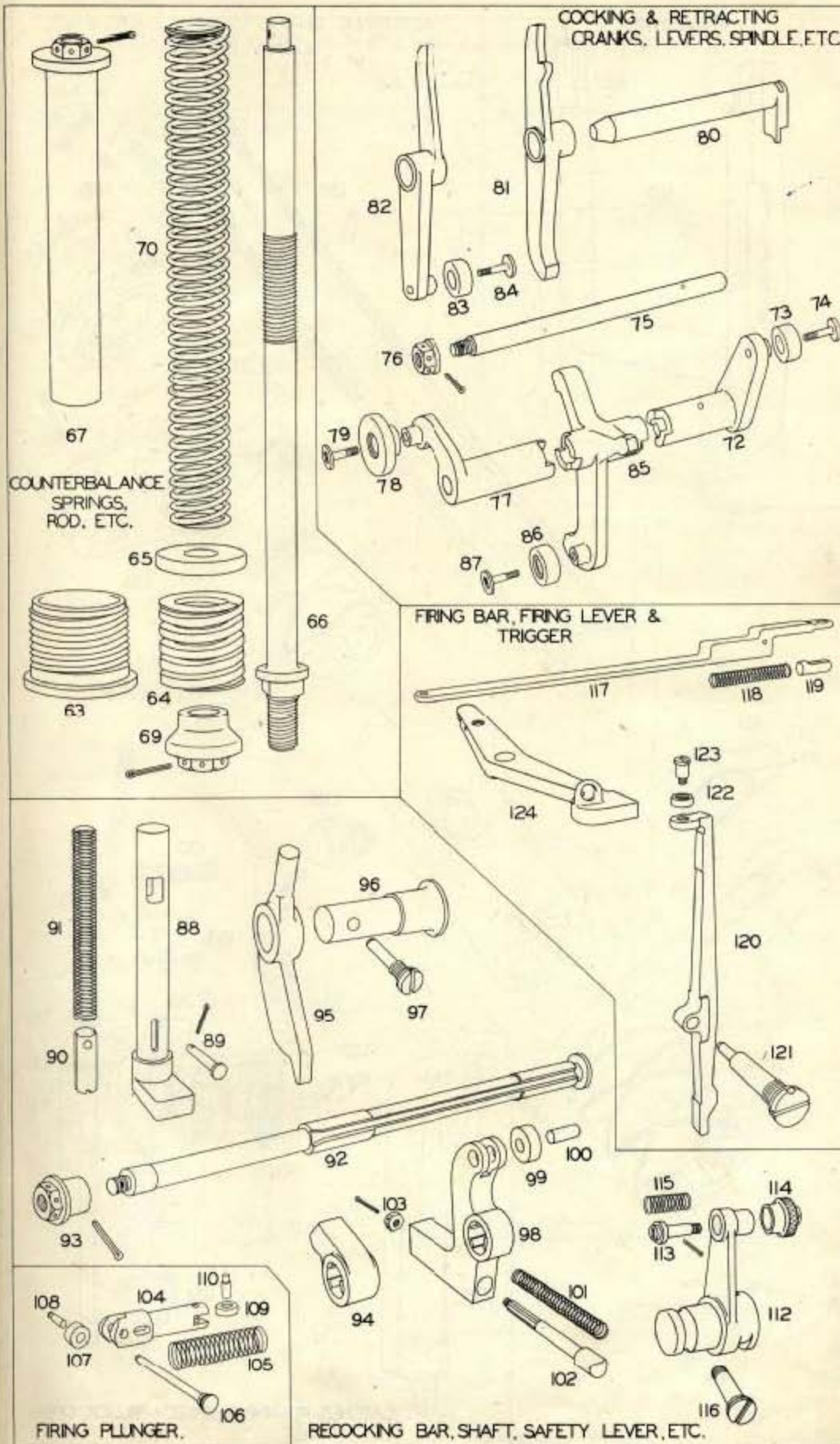
# FIRING CASE.



# TRIGGER SEAR & PLUNGER.

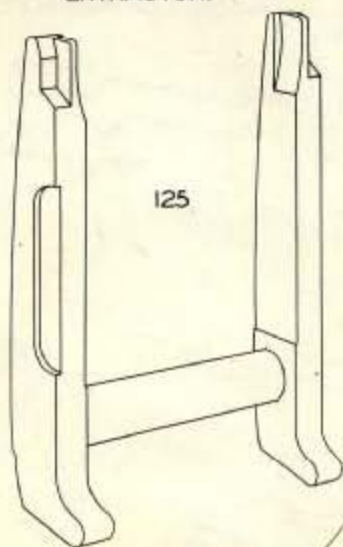




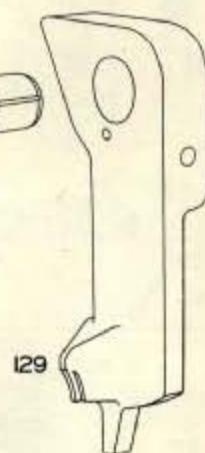
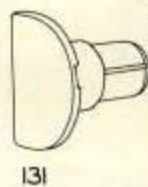
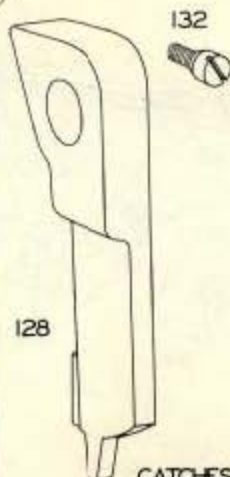
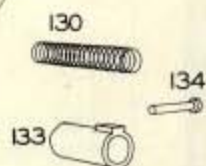
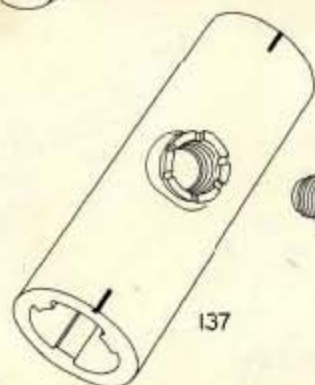
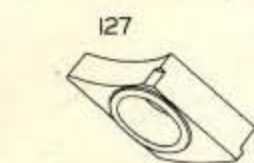
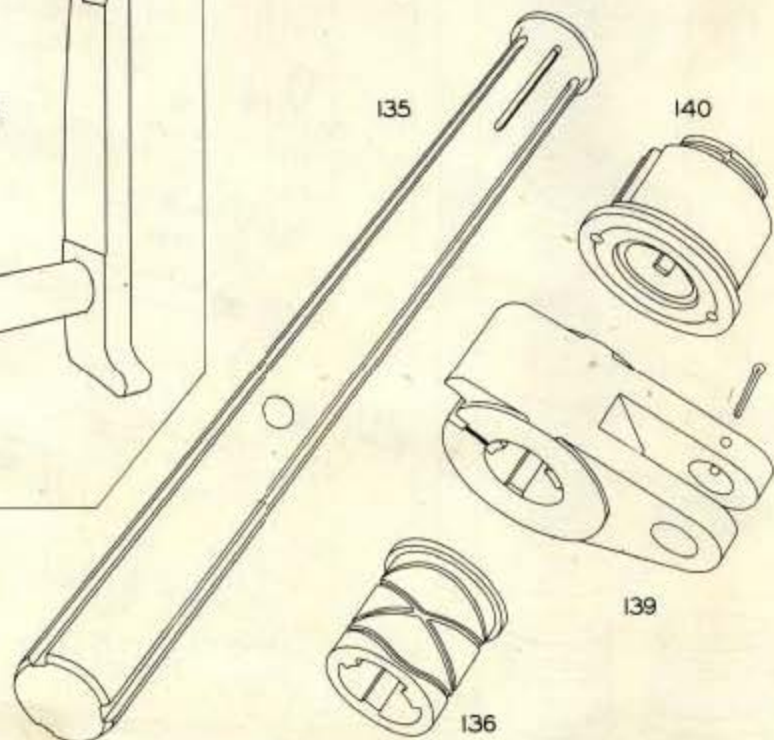




EXTRACTOR.



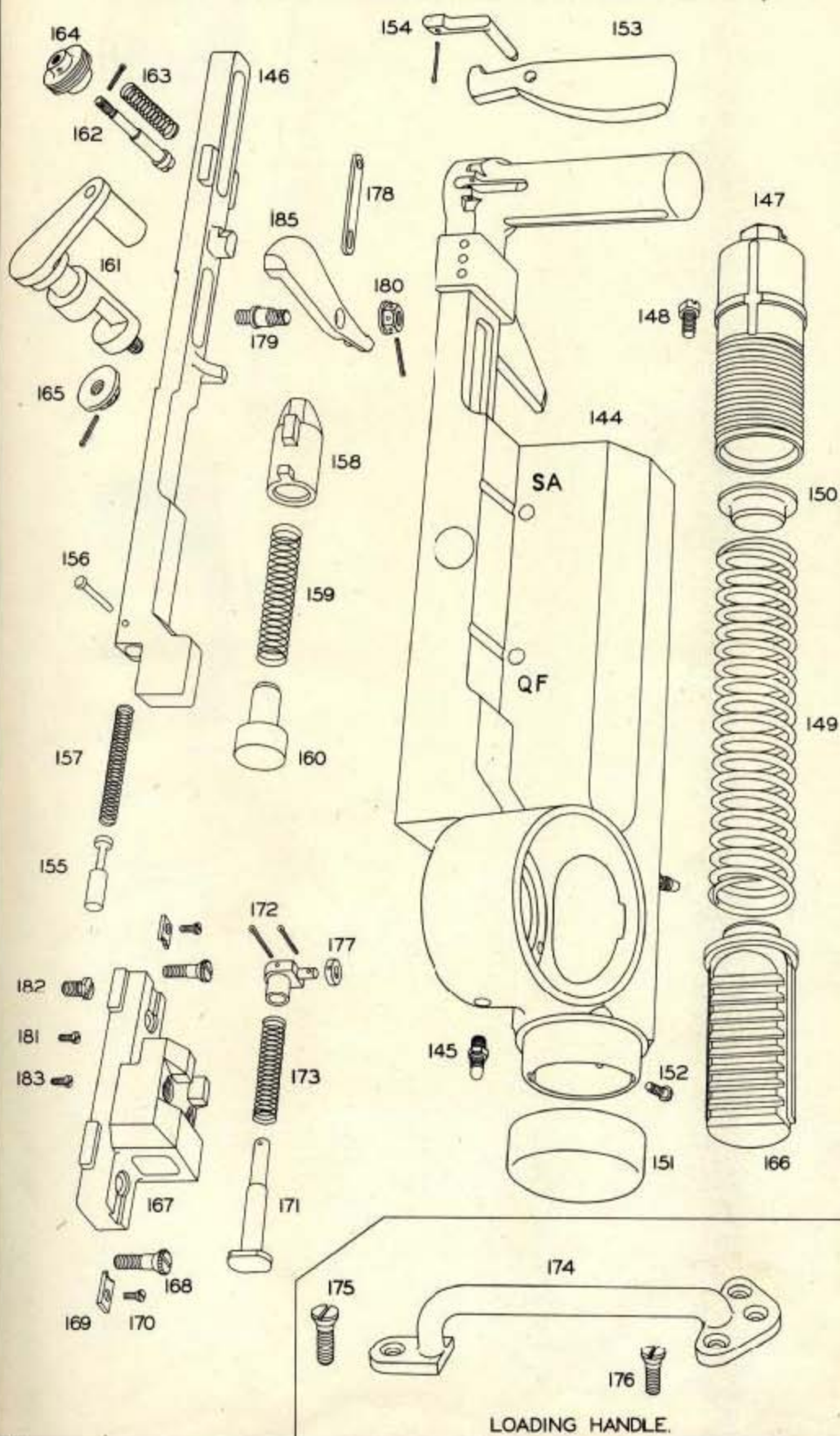
ACTUATING SHAFT, CRANK, LEVER, Etc.  
SLIDING BLOCK.



CATCHES RETAINING BREECH BLOCK OPEN.

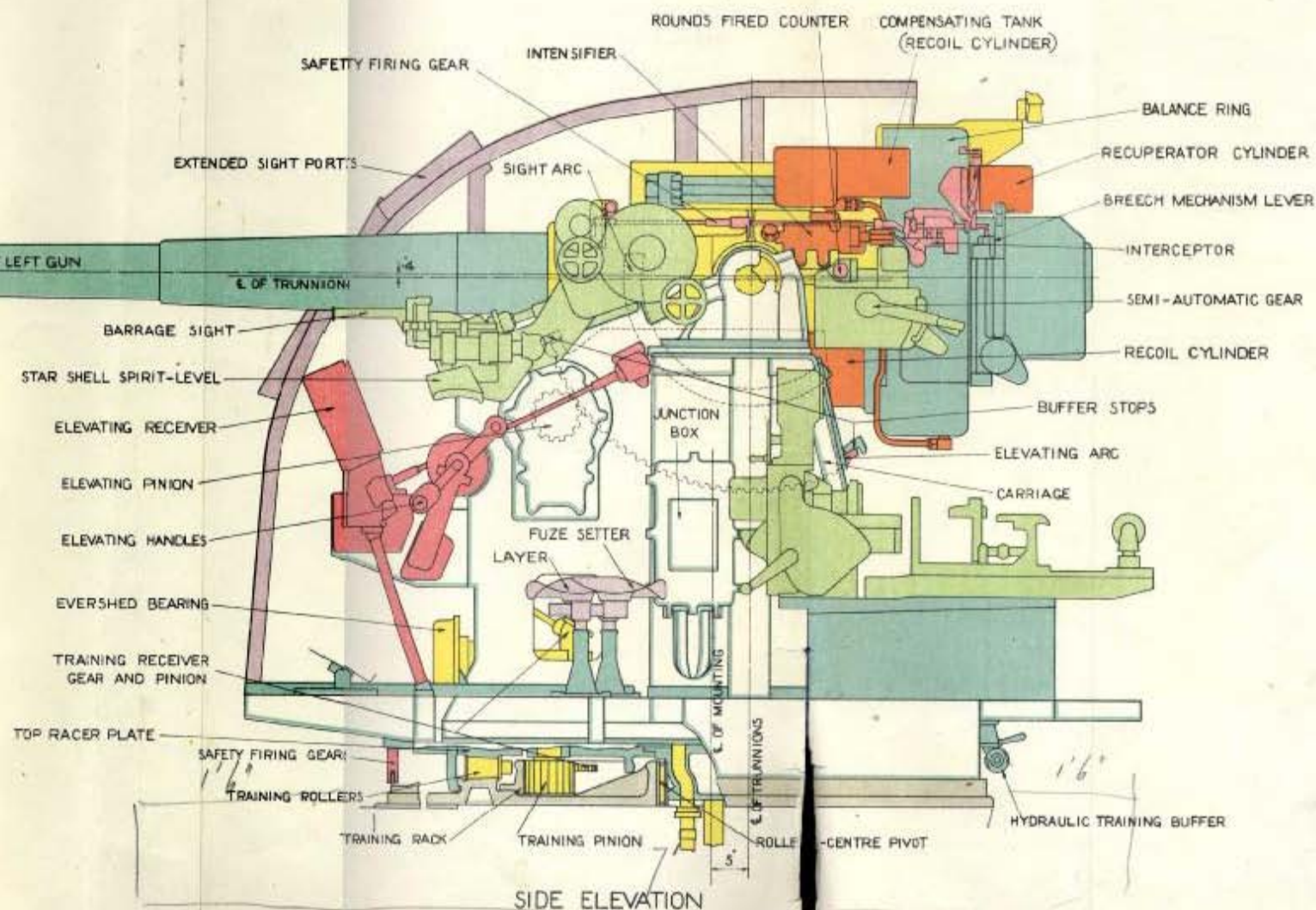


B.M. LEVER, CATCH BAR, ETC. (RIGHT SIDE) AND BRACKET STOP.





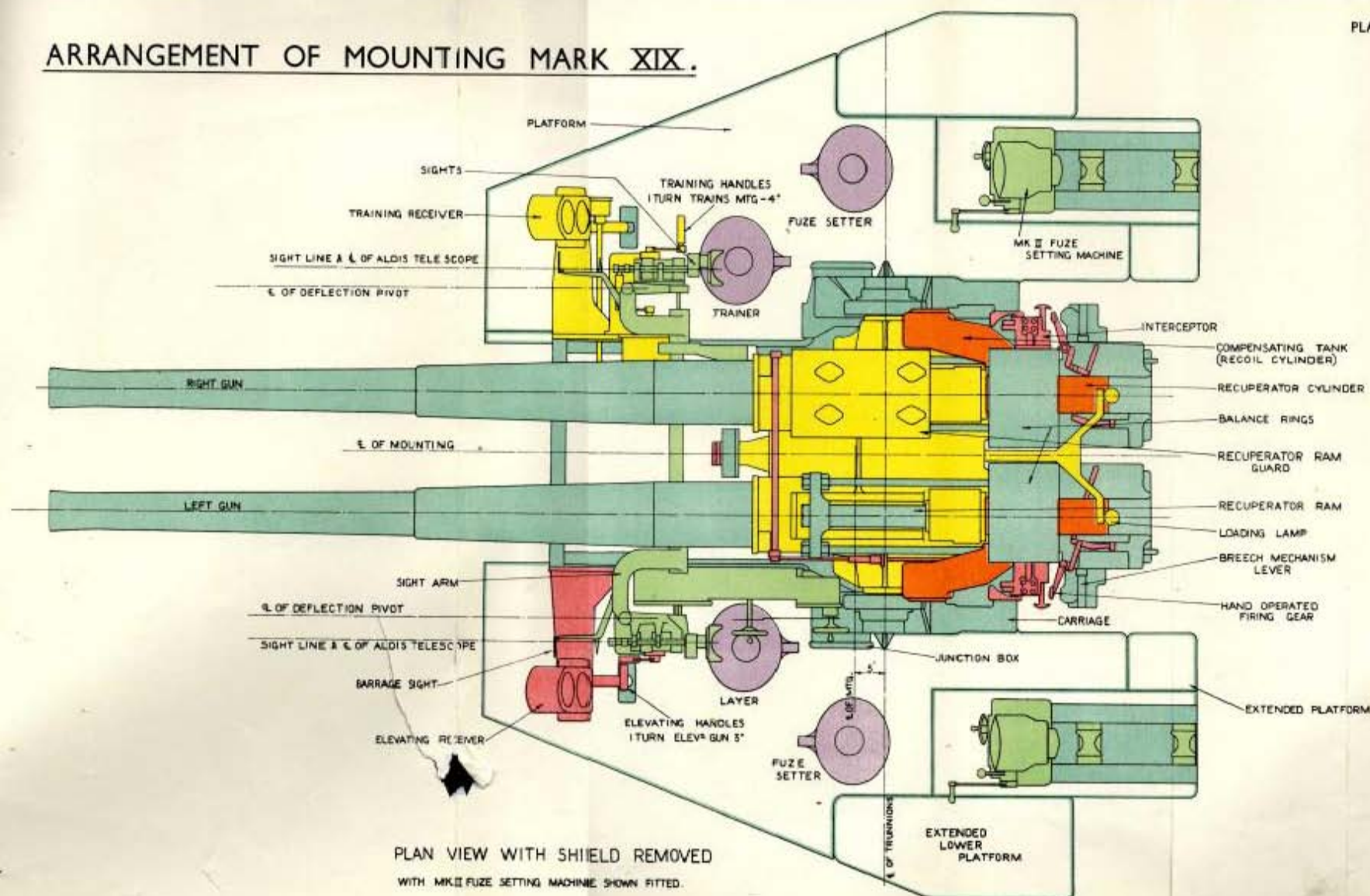
# ARRANGEMENT OF MOUNTING MARK XIX.



WITH MK.V FUZE SETTING MACHINE SHOWN ATTACHED.



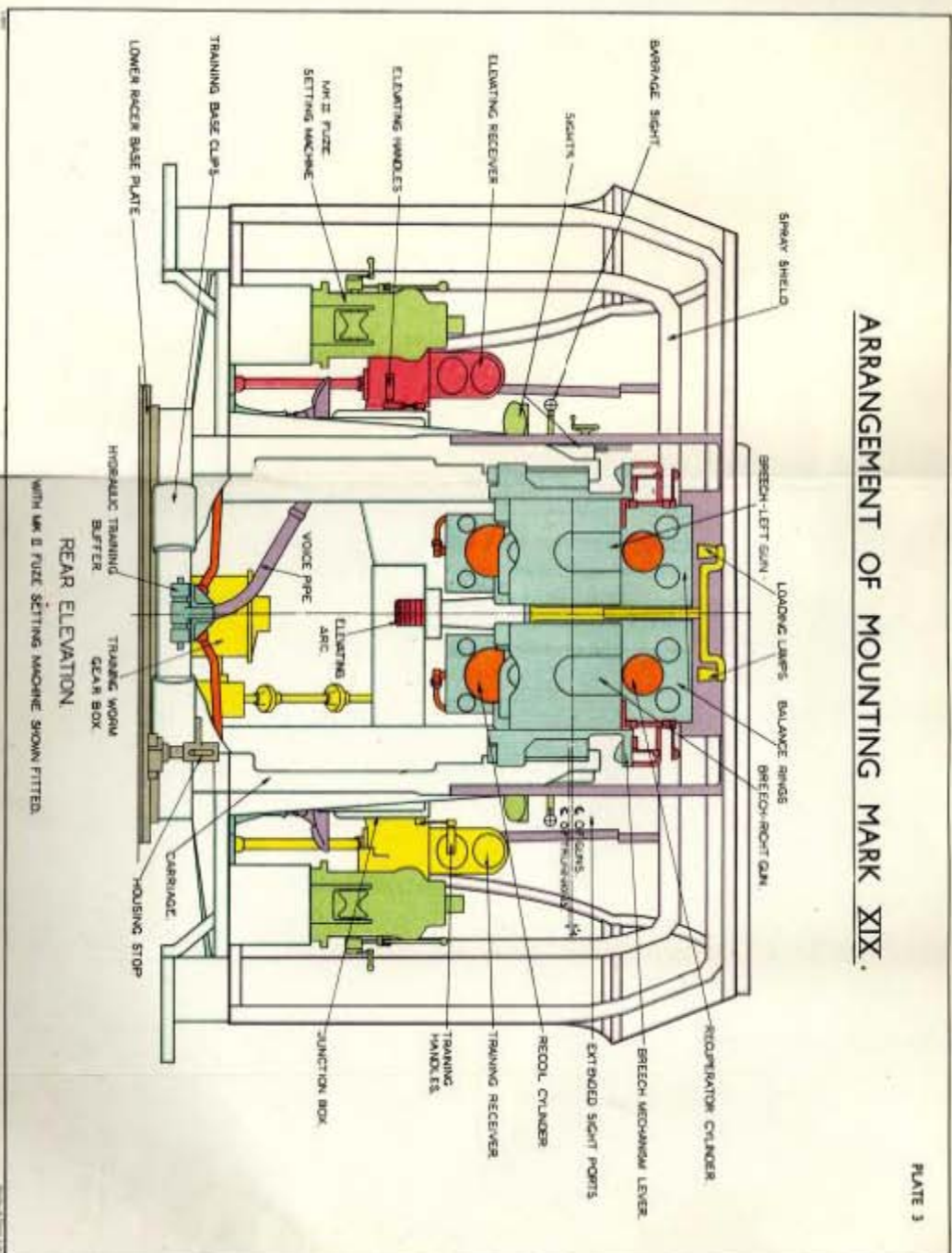
# ARRANGEMENT OF MOUNTING MARK XIX.





# ARRANGEMENT OF MOUNTING MARK XIX.

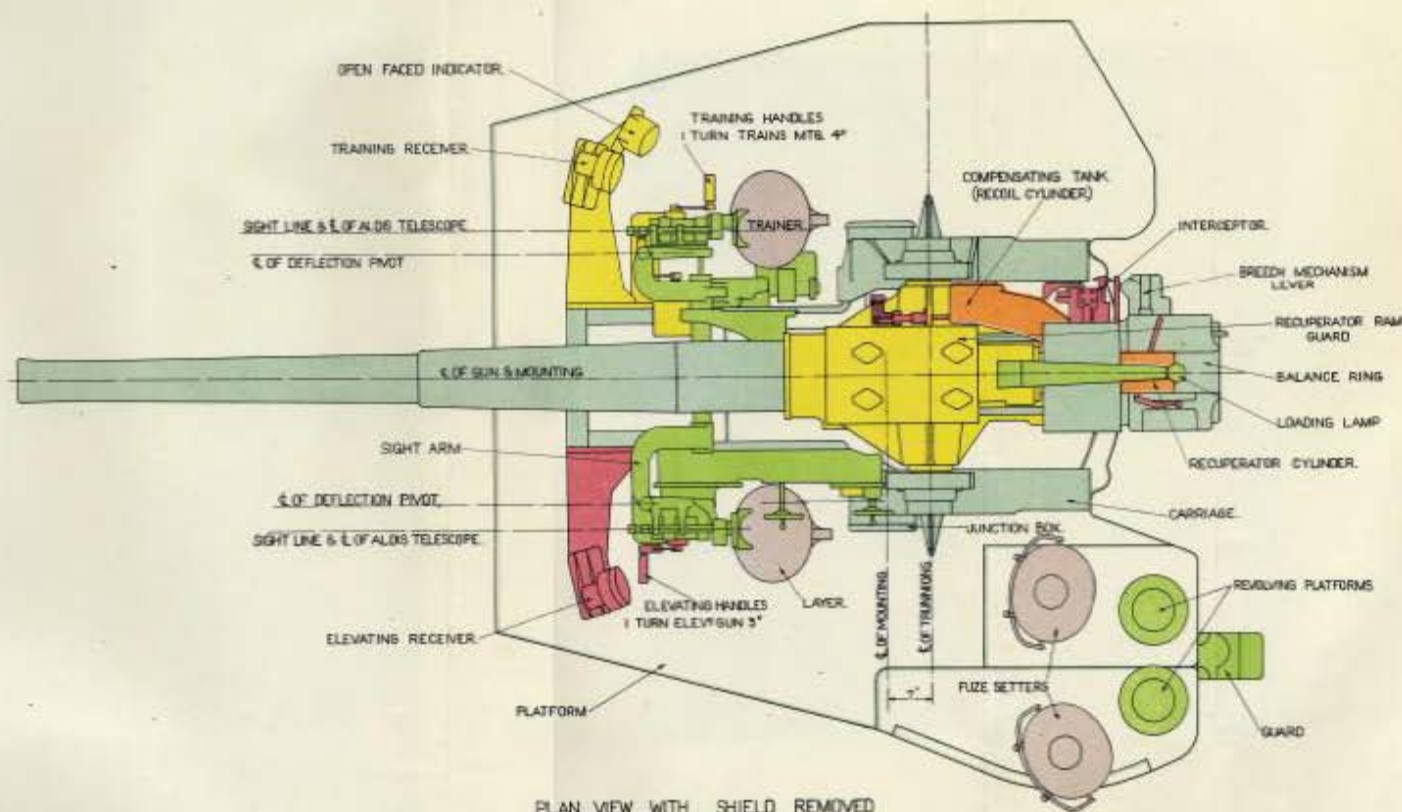
PLATE 3





# ARRANGEMENT OF MOUNTING MARK XX.

PLATE 4

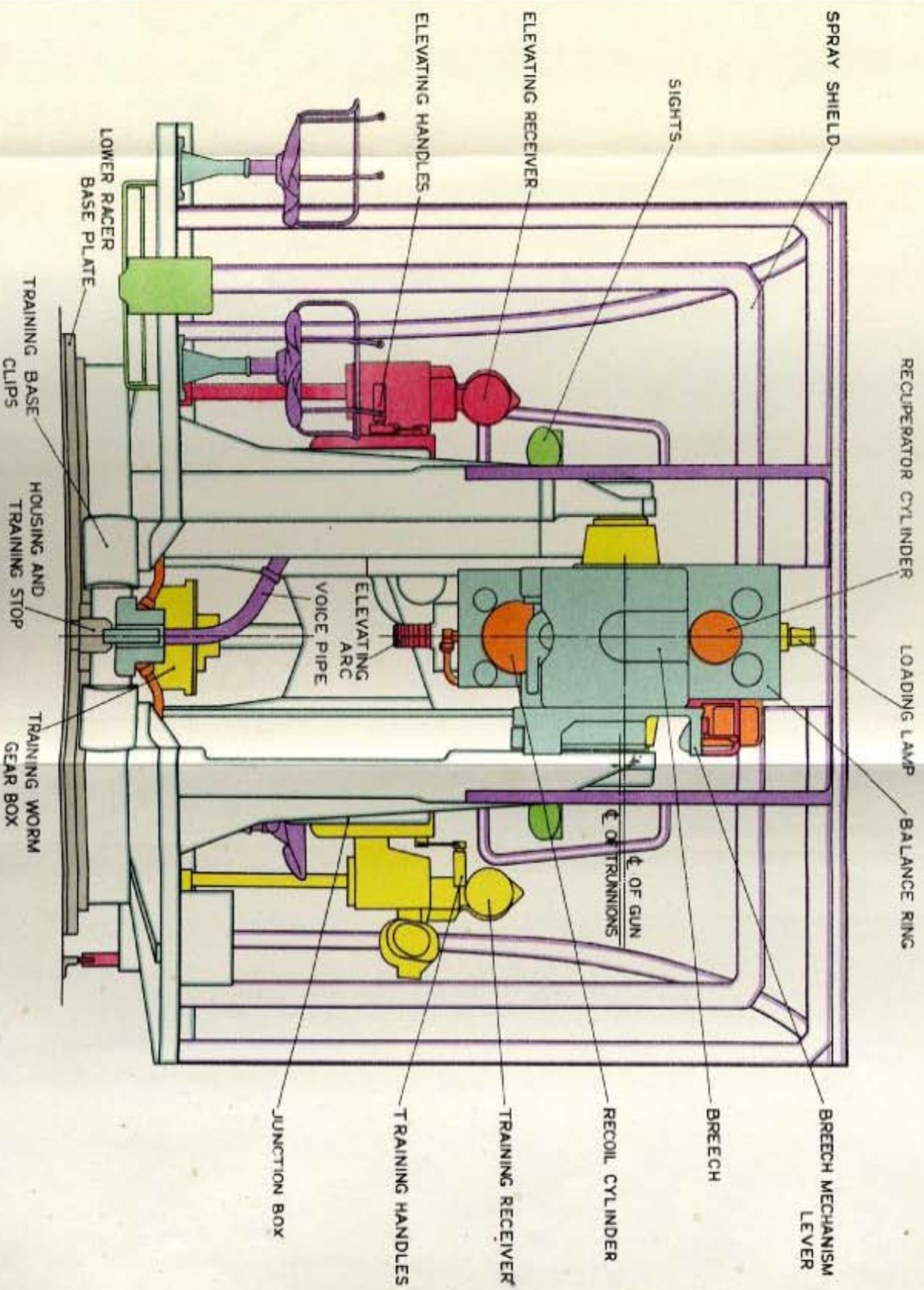


PLAN VIEW WITH SHIELD REMOVED  
WITH HAND FUZE SETTING ARRANGEMENT SHOWN FITTED



# ARRANGEMENT OF MOUNTING, MARK XX.

PLATE 5





TYPE, LENGTH OF RUN	NO. 5
LOCAL BARRAGE	867.0
PIERCE	84.5



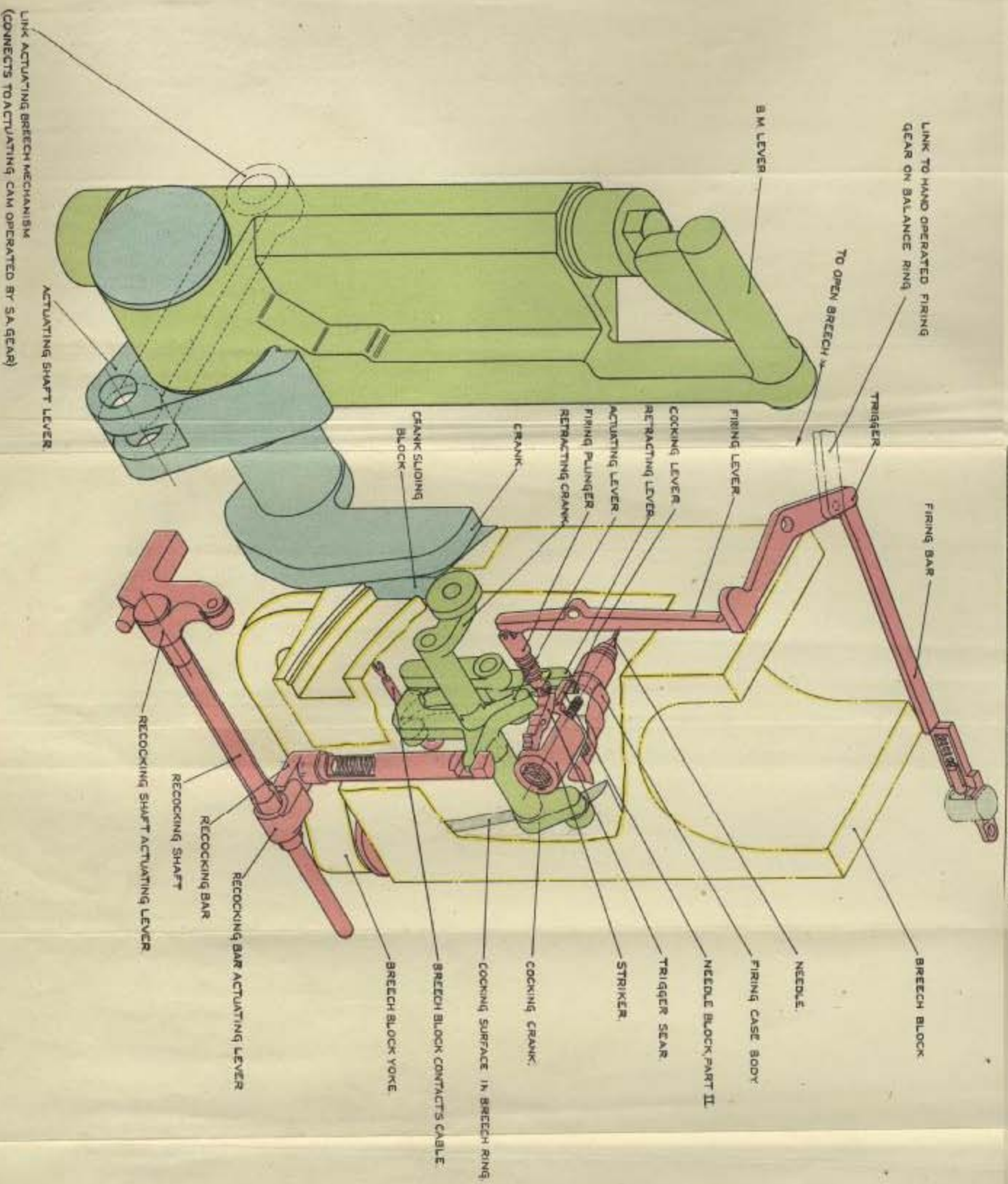
Experiments	Time	Temp	Rate
1	10 min	100°C	0.001
2	10 min	100°C	0.001
3	10 min	100°C	0.001
4	10 min	100°C	0.001
5	10 min	100°C	0.001
6	10 min	100°C	0.001
7	10 min	100°C	0.001
8	10 min	100°C	0.001
9	10 min	100°C	0.001
10	10 min	100°C	0.001
11	10 min	100°C	0.001
12	10 min	100°C	0.001
13	10 min	100°C	0.001
14	10 min	100°C	0.001
15	10 min	100°C	0.001
16	10 min	100°C	0.001
17	10 min	100°C	0.001
18	10 min	100°C	0.001
19	10 min	100°C	0.001
20	10 min	100°C	0.001
21	10 min	100°C	0.001
22	10 min	100°C	0.001
23	10 min	100°C	0.001
24	10 min	100°C	0.001
25	10 min	100°C	0.001
26	10 min	100°C	0.001
27	10 min	100°C	0.001
28	10 min	100°C	0.001
29	10 min	100°C	0.001
30	10 min	100°C	0.001
31	10 min	100°C	0.001
32	10 min	100°C	0.001
33	10 min	100°C	0.001
34	10 min	100°C	0.001
35	10 min	100°C	0.001
36	10 min	100°C	0.001
37	10 min	100°C	0.001
38	10 min	100°C	0.001
39	10 min	100°C	0.001
40	10 min	100°C	0.001
41	10 min	100°C	0.001
42	10 min	100°C	0.001
43	10 min	100°C	0.001
44	10 min	100°C	0.001
45	10 min	100°C	0.001
46	10 min	100°C	0.001
47	10 min	100°C	0.001
48	10 min	100°C	0.001
49	10 min	100°C	0.001
50	10 min	100°C	0.001
51	10 min	100°C	0.001
52	10 min	100°C	0.001
53	10 min	100°C	0.001
54	10 min	100°C	0.001
55	10 min	100°C	0.001
56	10 min	100°C	0.001
57	10 min	100°C	0.001
58	10 min	100°C	0.001
59	10 min	100°C	0.001
60	10 min	100°C	0.001
61	10 min	100°C	0.001
62	10 min	100°C	0.001
63	10 min	100°C	0.001
64	10 min	100°C	0.001
65	10 min	100°C	0.001
66	10 min	100°C	0.001
67	10 min	100°C	0.001
68	10 min	100°C	0.001
69	10 min	100°C	0.001
70	10 min	100°C	0.001
71	10 min	100°C	0.001
72	10 min	100°C	0.001
73	10 min	100°C	0.001
74	10 min	100°C	0.001
75	10 min	100°C	0.001
76	10 min	100°C	0.001
77	10 min	100°C	0.001
78	10 min	100°C	0.001
79	10 min	100°C	0.001
80	10 min	100°C	0.001
81	10 min	100°C	0.001
82	10 min	100°C	0.001
83	10 min	100°C	0.001
84	10 min	100°C	0.001
85	10 min	100°C	0.001
86	10 min	100°C	0.001
87	10 min	100°C	0.001
88	10 min	100°C	0.001
89	10 min	100°C	0.001
90	10 min	100°C	0.001
91	10 min	100°C	0.001
92	10 min	100°C	0.001
93	10 min	100°C	0.001
94	10 min	100°C	0.001
95	10 min	100°C	0.001
96	10 min	100°C	0.001
97	10 min	100°C	0.001
98	10 min	100°C	0.001
99	10 min	100°C	0.001
100	10 min	100°C	0.001







# BREECH MECHANISM - DIAGRAMMATIC ARRANGEMENT - LEFT GUN.



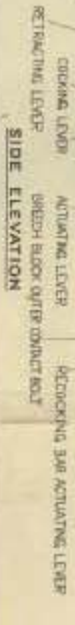






(LEFT GUN SHOWN; TYPICAL FOR RIGHT GUN)

(LEFT)



REAR ELEVATION



(LEFT GUN SHOWN: TYPICAL FOR RIGHT GUN).

PALM LEVER (PROM. CLEAR)

BALANCE FORWARD

TRUCKER

FLAMES, LEVIES

CHINESE MAN

THE END BOOK

### EXTRACTOR

FRING. HOLE BUSH

NETDLE

CONTACT HERE

NEEDLE BLOCK PART I  
NEEDLE BLOCK PART II  
NEEDLE INSULATING WASHER  
NEEDLE REGULATING DUSH

NEEDLE NUT

BEECH BUDS: NUMBER CONTACT BUSH

CONVENS

BREATH MECHANISM LEVER

(U.S. MAIL PERMIT NO. 67)

PLAN.

### EXTRACTOR

NEEDLE BLOCK PART I  
NEEDLE BLOCK PART II  
NEEDLE INSULATING WASHER  
NEEDLE REGULATING DUSH

NEEDLE NUT

BEECH BUDS: NUMBER CONTACT BUSH

CONVENS

BREATH MECHANISM LEVER

(U.S. MAIL PERMIT NO. 670)

PLAN.

FRANK PUNNETT

STIMULI

### POSTMARKING PLATE

SECTIONAL PLAN

STROUD SPRING

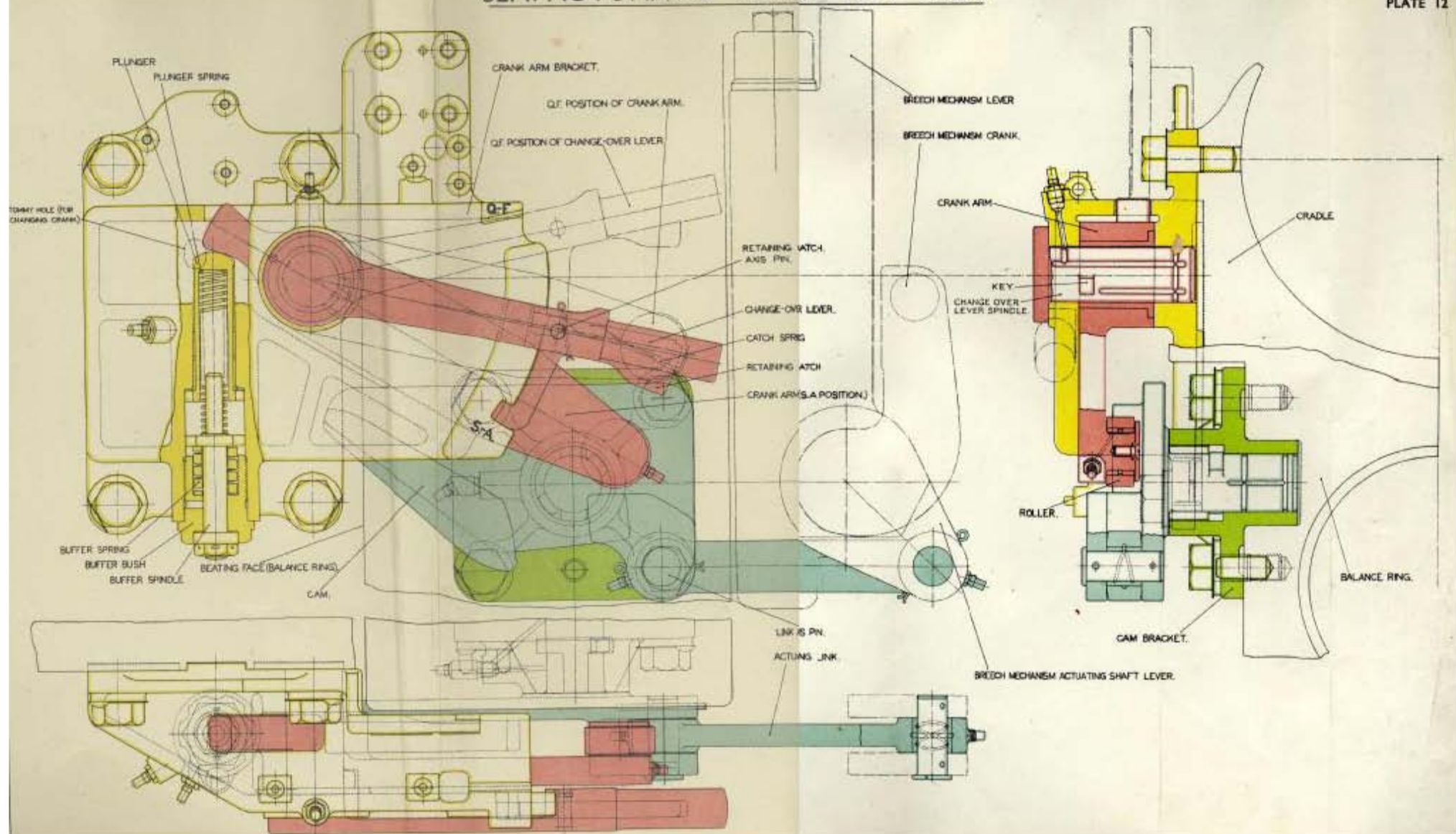
SECTIONAL PLAN.

PLAN.



# SEMI-AUTOMATIC GEAR LEFT GUN.

PLATE 12

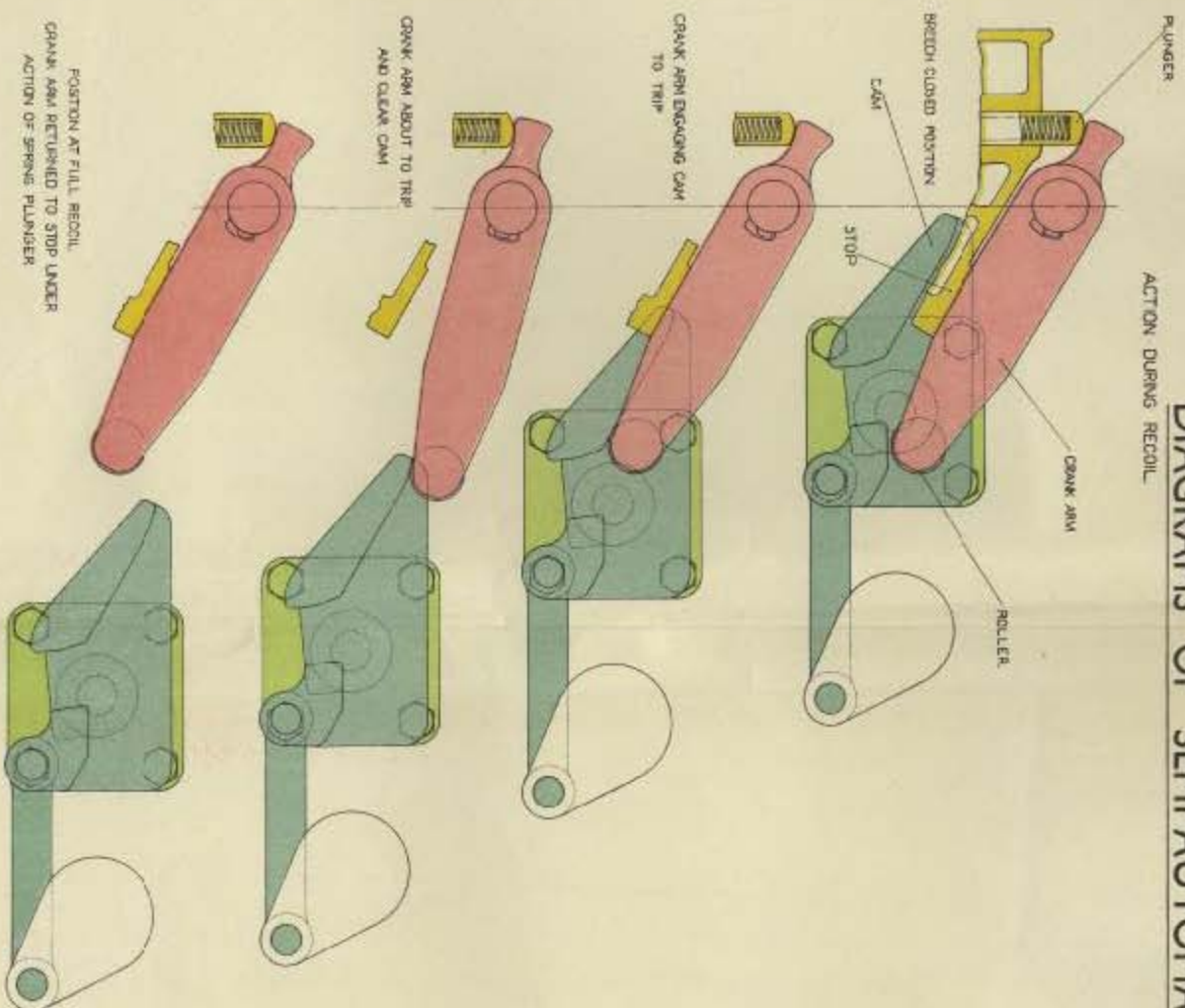




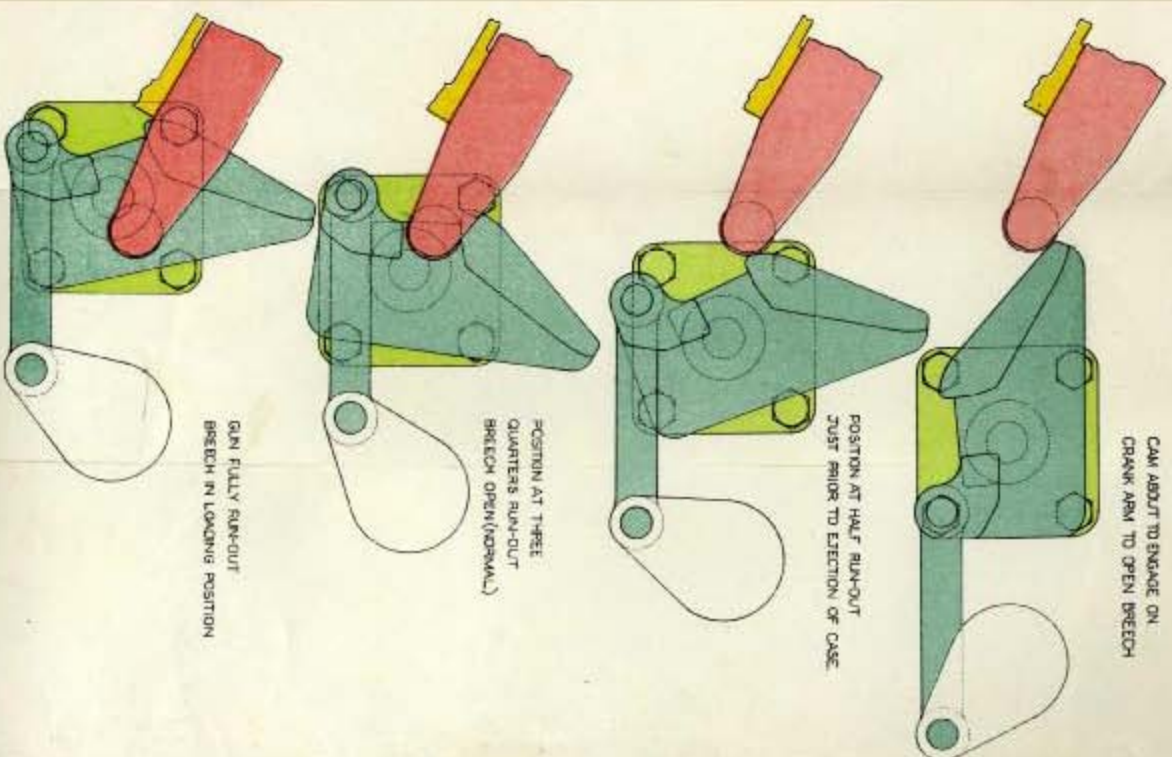
# DIAGRAMS OF SEMI-AUTOMATIC GEAR OPERATION

PLATE 13

ACTION DURING RECOIL



ACTION DURING RUN-OUT



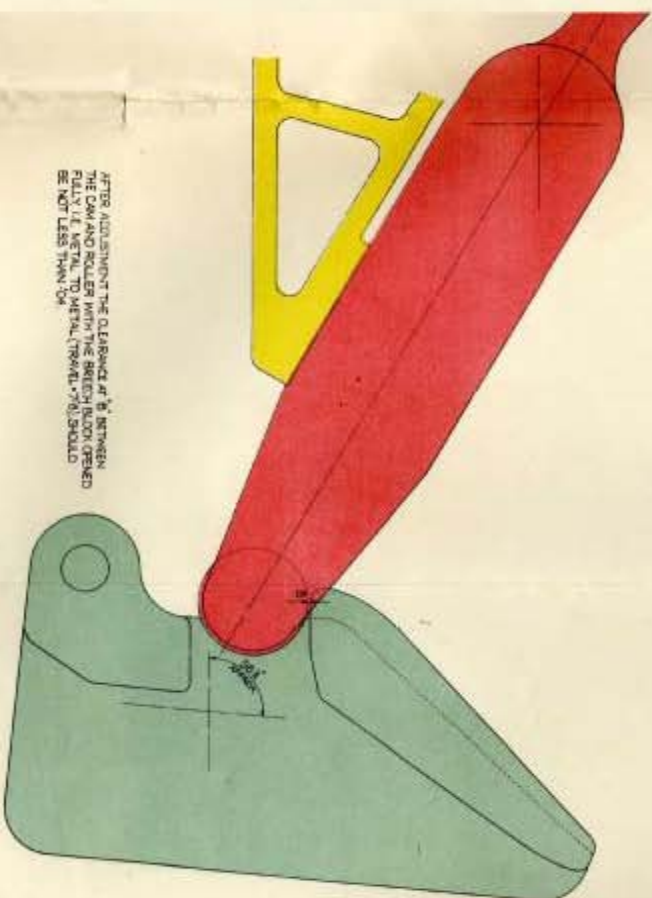


# ADJUSTMENT OF S-A. GEAR.

PLATE 14



NOTE ON BRACKET TO BE ADJUSTED (IF NECESSARY)  
TO GIVE A MOVEMENT OF THE BRECH BLOCK OF 7.25 TO 14.5  
UNDER SLOW S.A. ACTION, CARE BEING TAKEN TO GET  
A GOOD BEDDING SURFACE FOR THE CRANK ARM.



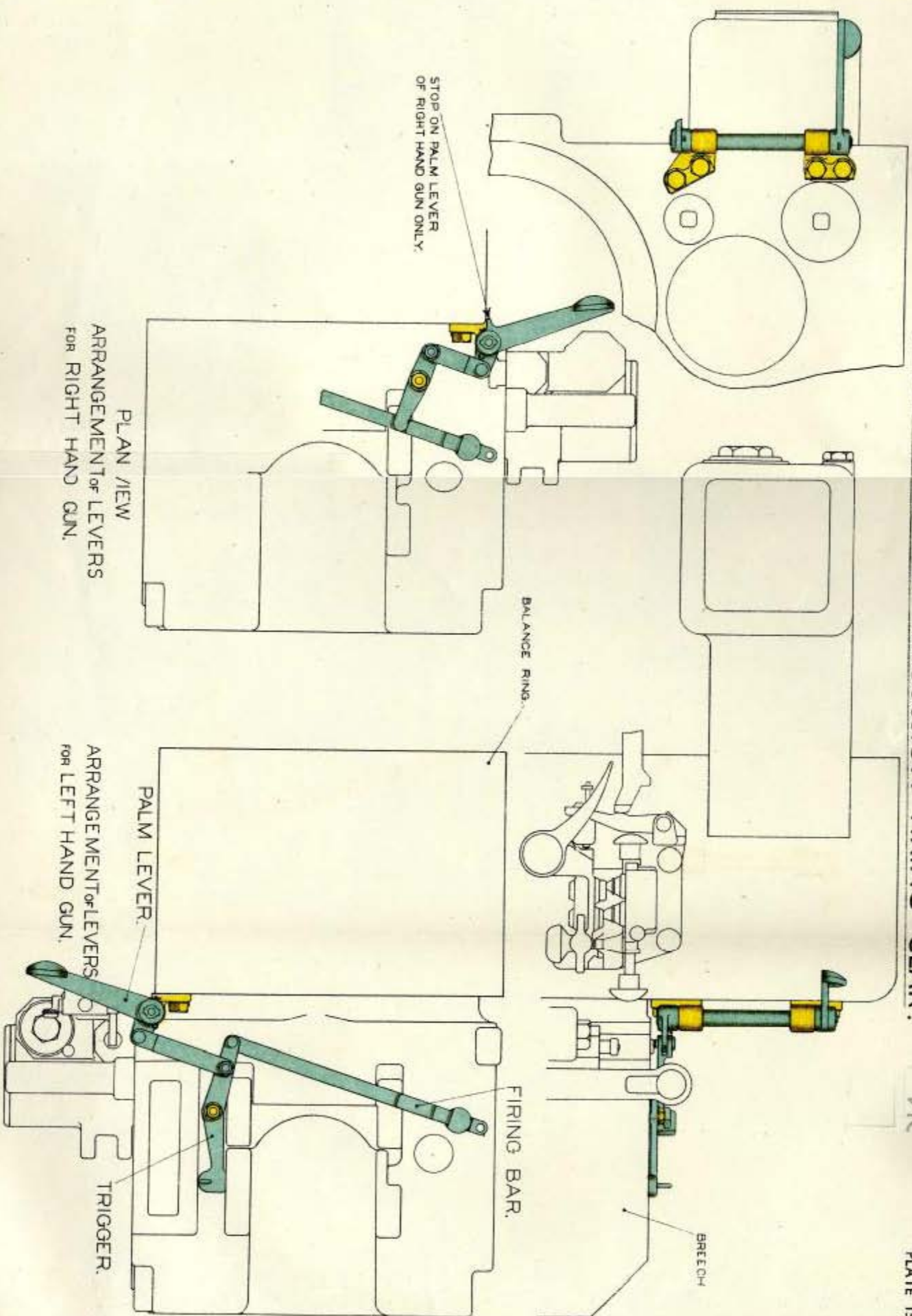
AFTER ADJUSTMENT THE CLEARANCE AT B BETWEEN  
THE CRANK ROLLER WITH THE BRECH BLOCK OPENED  
SHOULD BE EQUAL TO METAL THICKNESS (7.6) SHOULD  
BE NOT LESS THAN 50.



# HAND OPERATED PERCUSSION FIRING GEAR.

INC

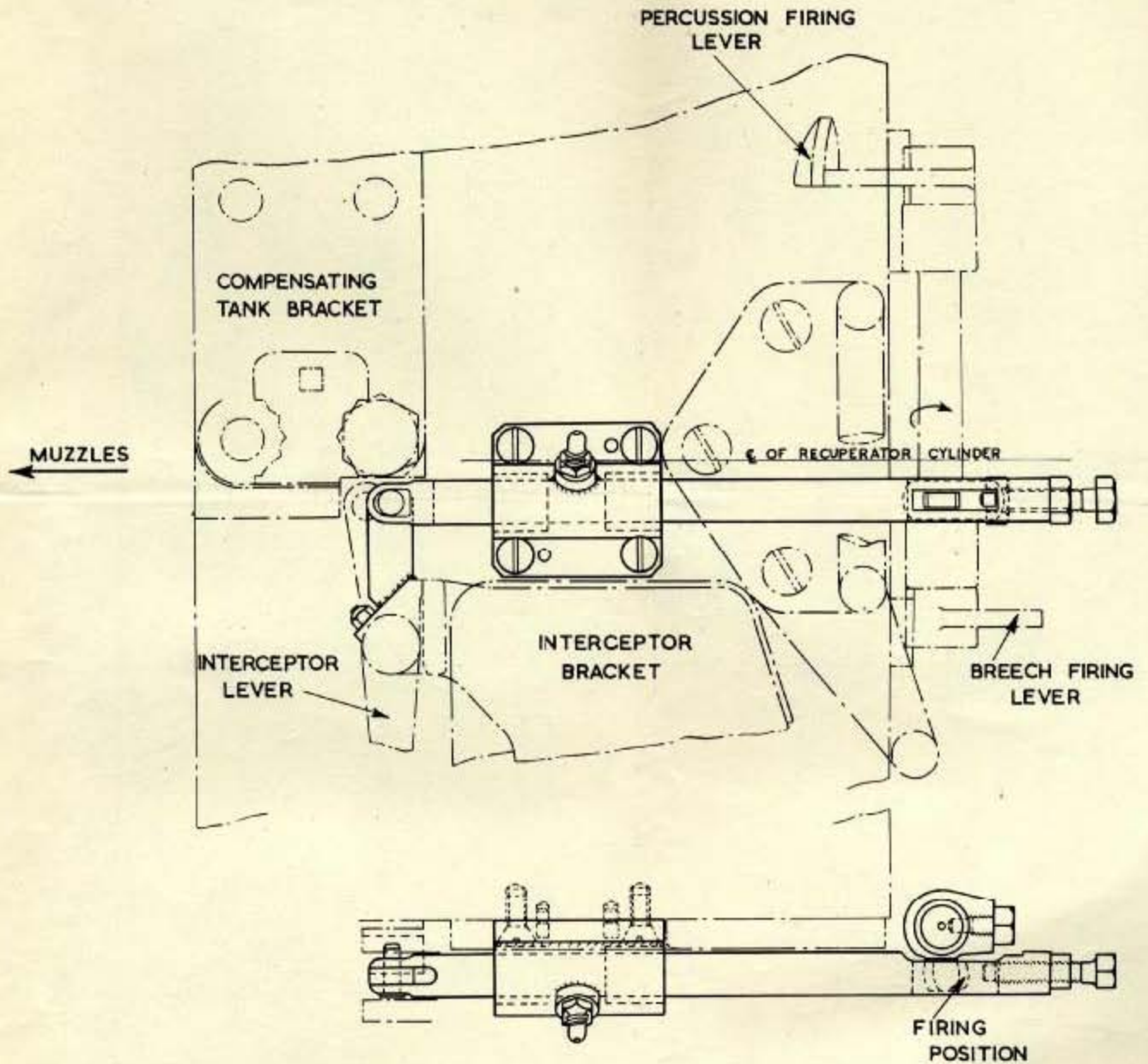
PLATE 15





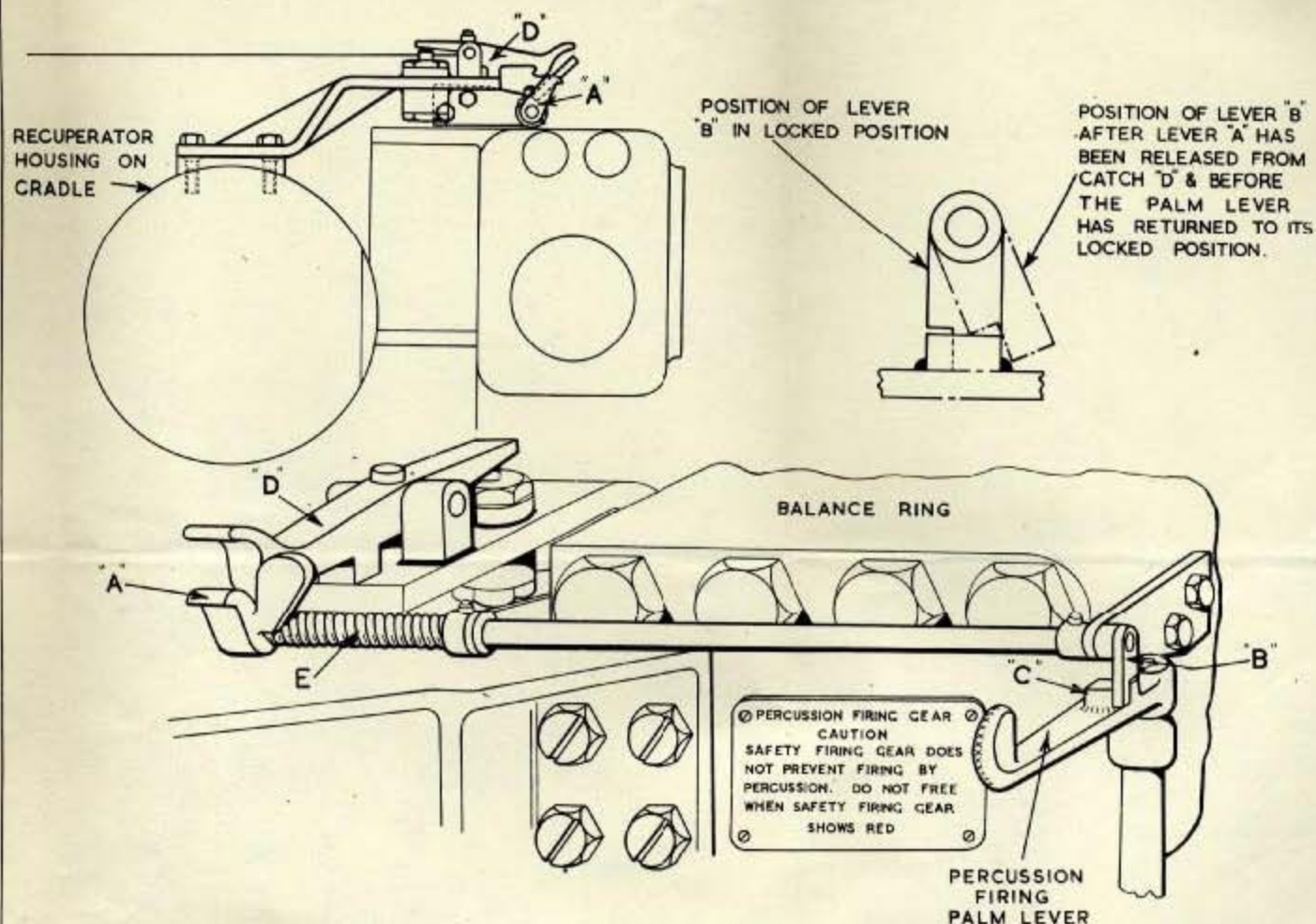
# 4 INCH H.A. TWIN MOUNTING MARK XIX

## ARRGT. OF SAFETY PERCUSSION FIRING GEAR.





# 4 IN. H.A. TWIN MK. XIX PERCUSSION FIRING GEAR INTERLOCK-FOR MOUNTINGS FITTED WITH SAFETY FIRING SWITCH GEAR



## DESCRIPTION

LOCKING LEVER "B" COMBINES WITH STOP "C" TO PREVENT MOVEMENT OF THE PALM LEVER. BEFORE THE PALM LEVER CAN BE OPERATED FOR PERCUSSION FIRING, LEVER "B" MUST BE RAISED CLEAR OF STOP "C". THIS IS DONE BY RAISING LEVER "A" INTO A VERTICAL POSITION AND CLIPPING IT UNDER CLIP "D". LEVERS "A" AND "B" ARE BOTH MOUNTED ON THE BALANCE RING AND RECOIL WITH THE GUN. CLIP "D" IS SECURED TO THE CRADLE AND REMAINS STATIONARY. AS SOON AS THE GUN BEGINS TO RECOIL, LEVER "A" (WHICH IS SPRING LOADED) IS DRAWN BACKWARDS CLEAR OF THE CLIP "D" AND DROPS DOWN.

LEVER "B" ALSO DROPS AND COMES TO REST ON TOP OF THE STOP "C" WHERE IT REMAINS DURING THE REMAINDER OF THE RECOIL.

WHEN THE BREECH MECHANISM RETURNS THE PALM LEVER TO ITS ORIGINAL POSITION, LOCKING LEVER "B" DROPS BEHIND THE STOP "C" AND PREVENTS THE GUN BEING AGAIN FIRED BY PERCUSSION UNTIL LEVER "A" IS RAISED AS ABOVE. WHEN THE GUN IS BEING FIRED ELECTRICALLY, BOTH LEVERS "A" AND "B" ARE KEPT IN THE DOWNWARD POSITION BY MEANS OF SPRING "E".



# TRAINING BASE, CENTRE PIVOT AND ROLLERS.

PLATE 16

FIG. 1.

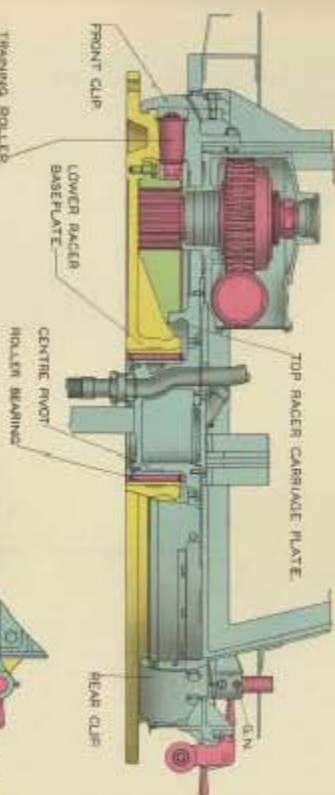


FIG. 2.

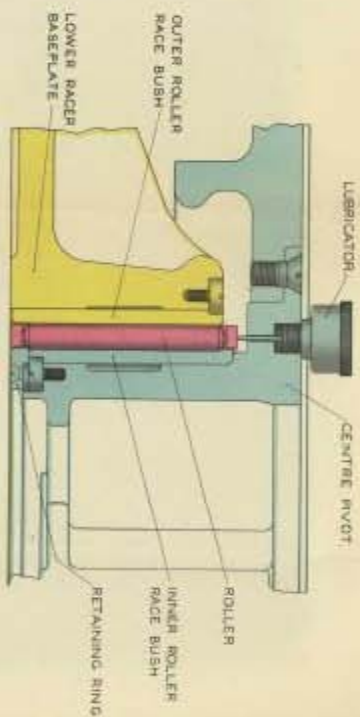


FIG. 3.

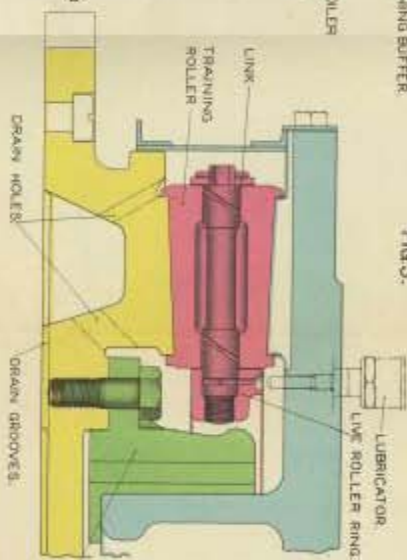
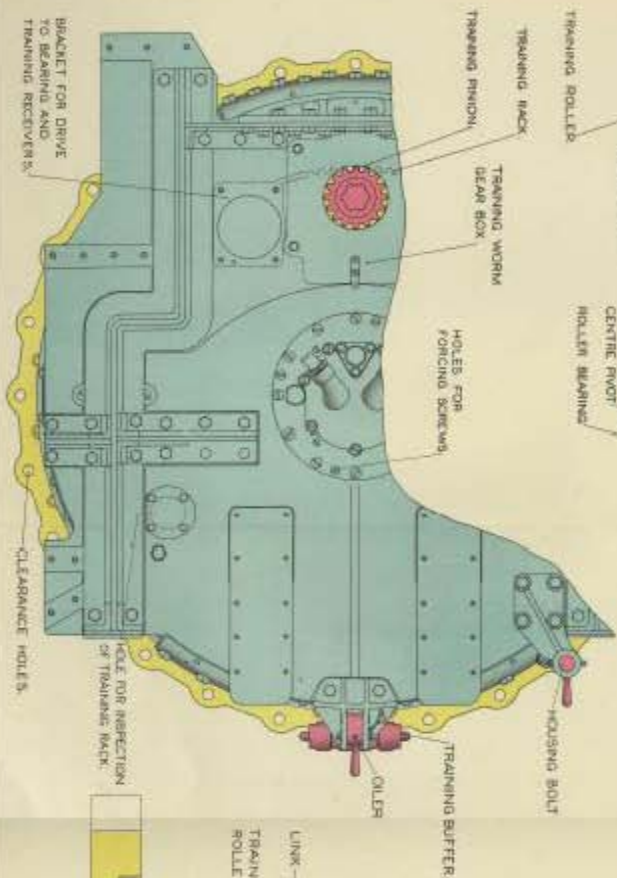
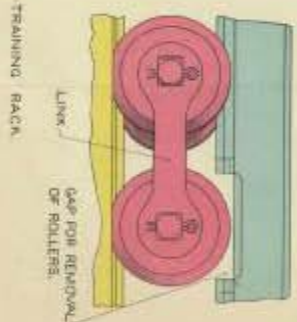


FIG. 4.

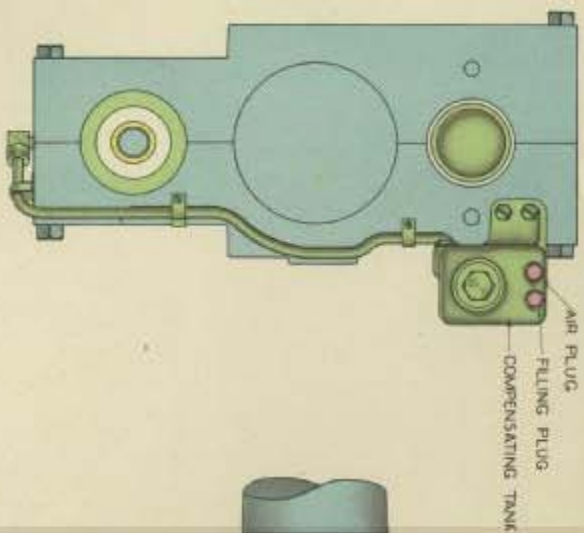


MANUFACTURED

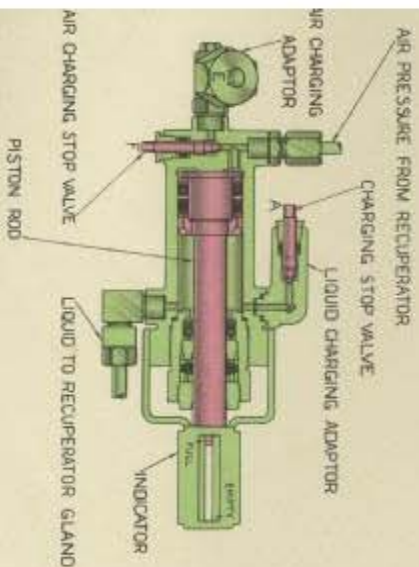
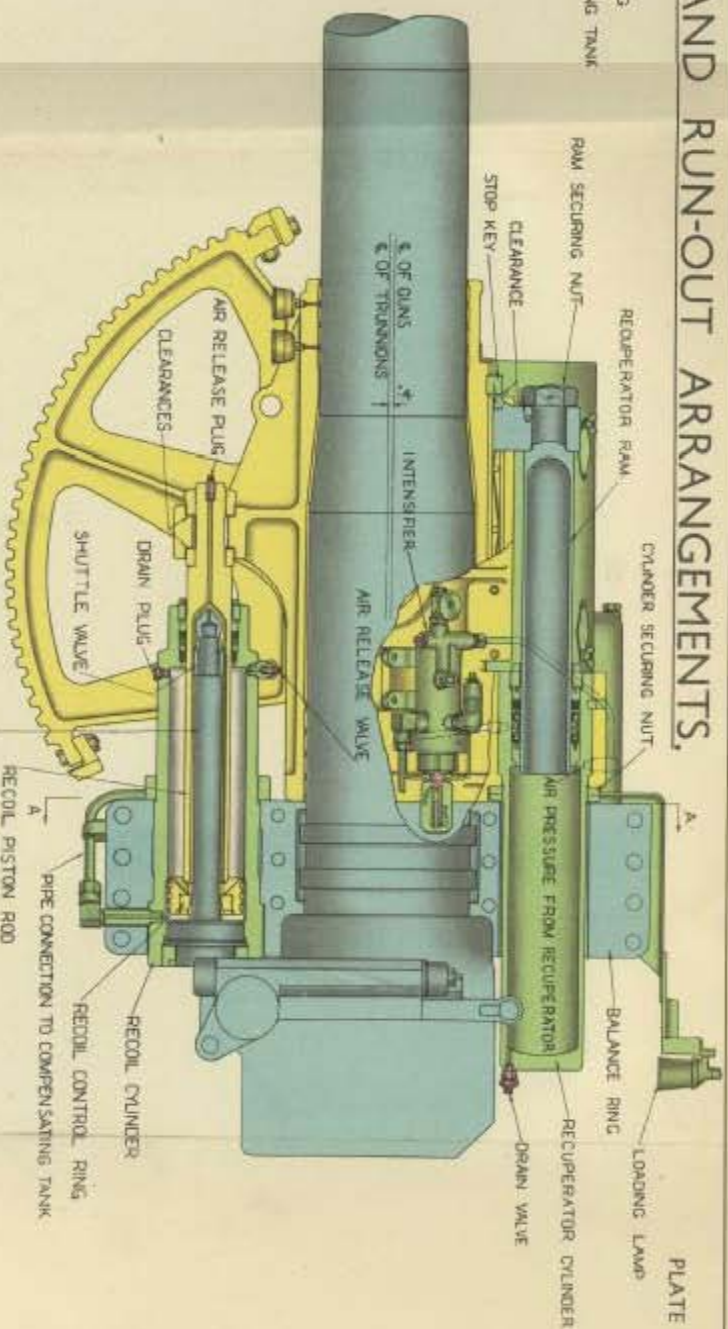


# CRADLE, RECOIL AND RUN-OUT ARRANGEMENTS.

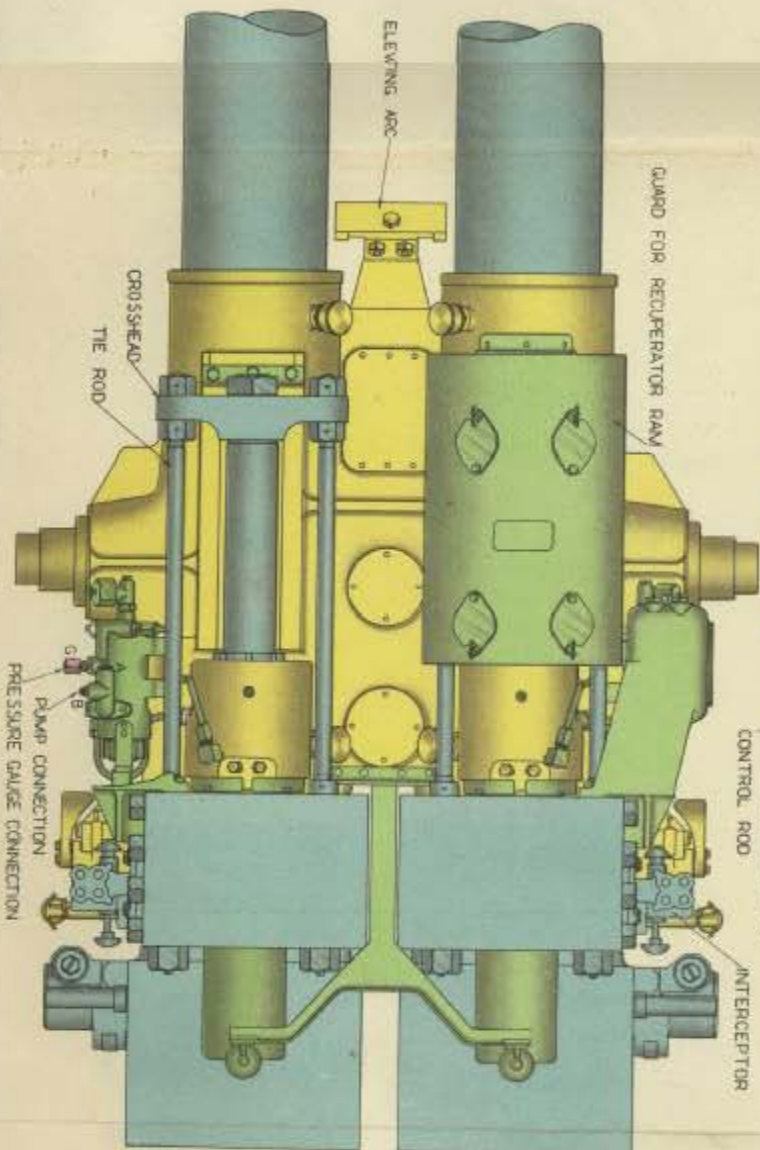
PLATE 17



SECTION AA



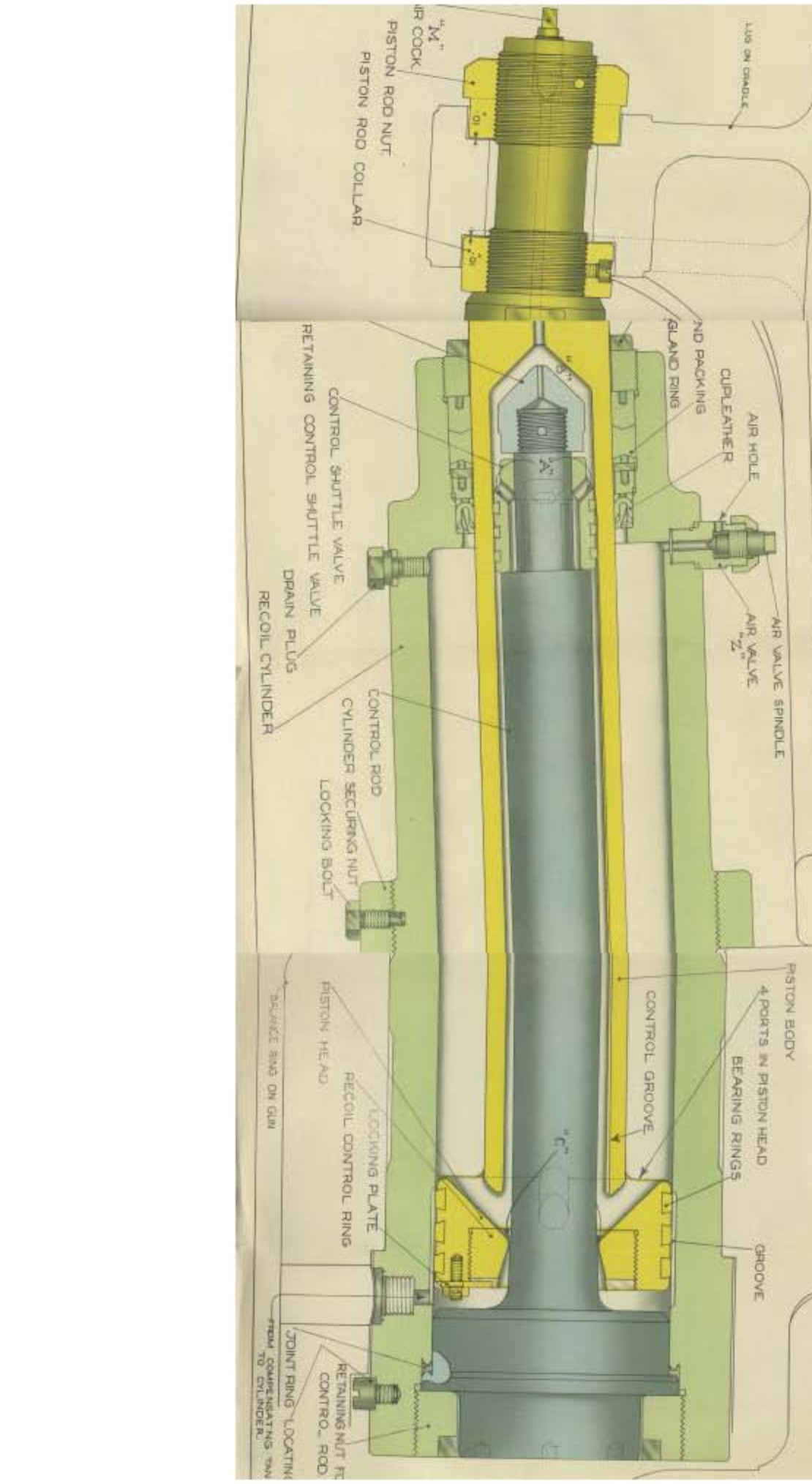
SECTION THRO INTENSIFIER





RECOIL CYLINDER

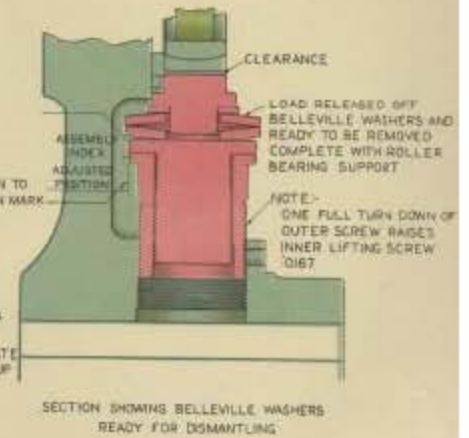
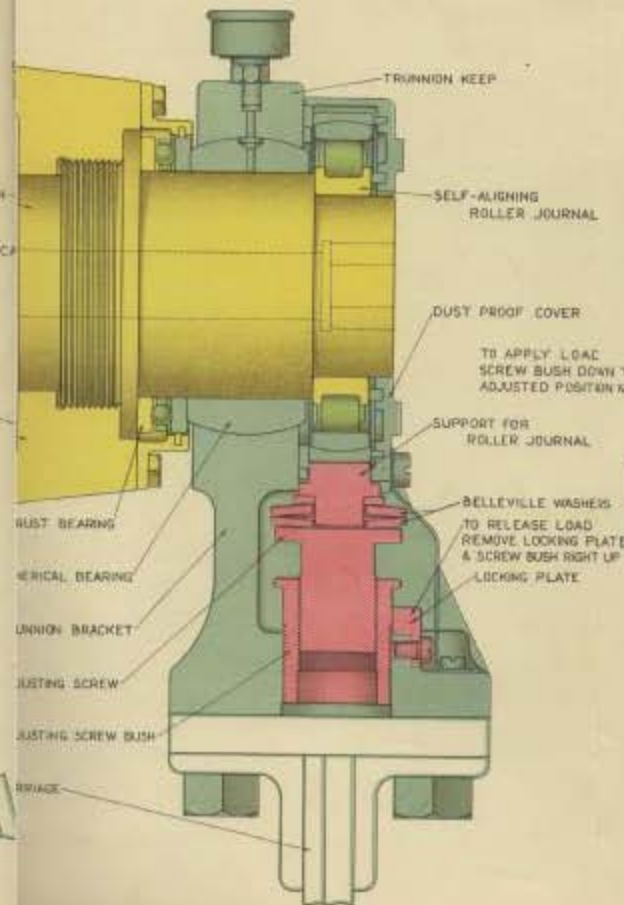
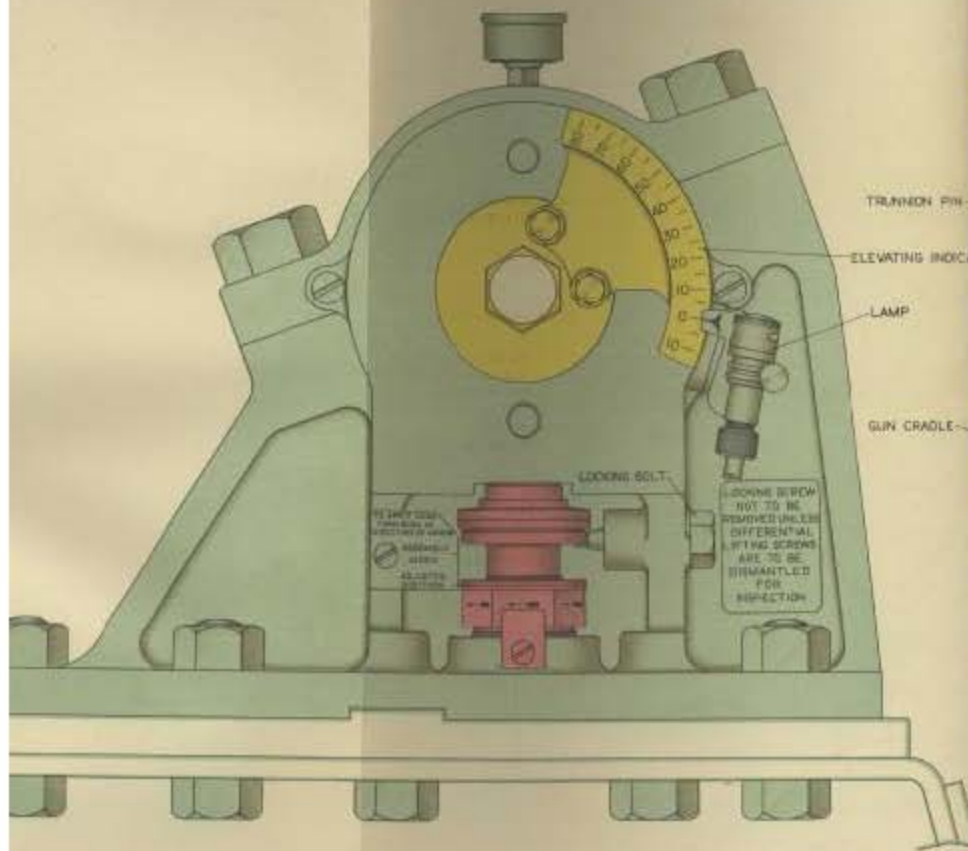
GUN BODY





# TRUNNION BEARING.

PLATE 19









SLIP TO SUPPORT ROD  
SLIP HOOK IS RELEASED

LINE SECURED TO SHIPS  
STRUCTURE TO PREVENT GEAR  
FALLING WHEN SLIP HOOK IS  
RELEASED

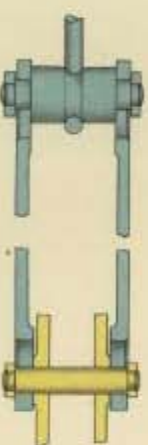
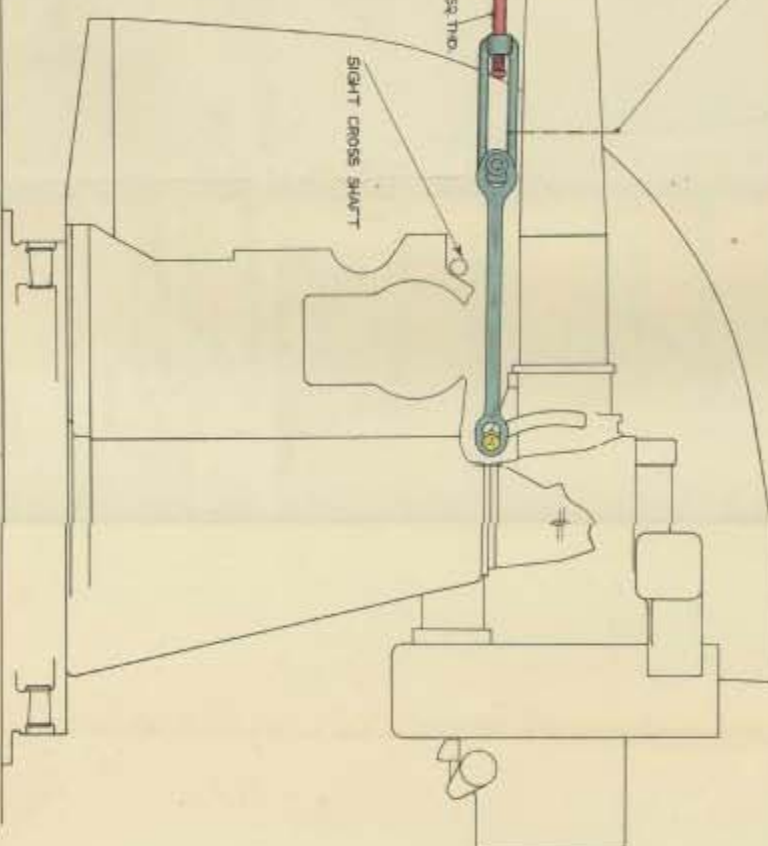
TEMPORARY SUPPORT STROP TO TAKE WEIGHT OF GEAR UNTIL LINKS ARE ASSEMBLED

RATCHET

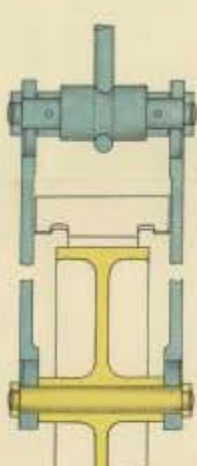
RH 5Q THD

62.710

SIGHT CROSS SHUTT



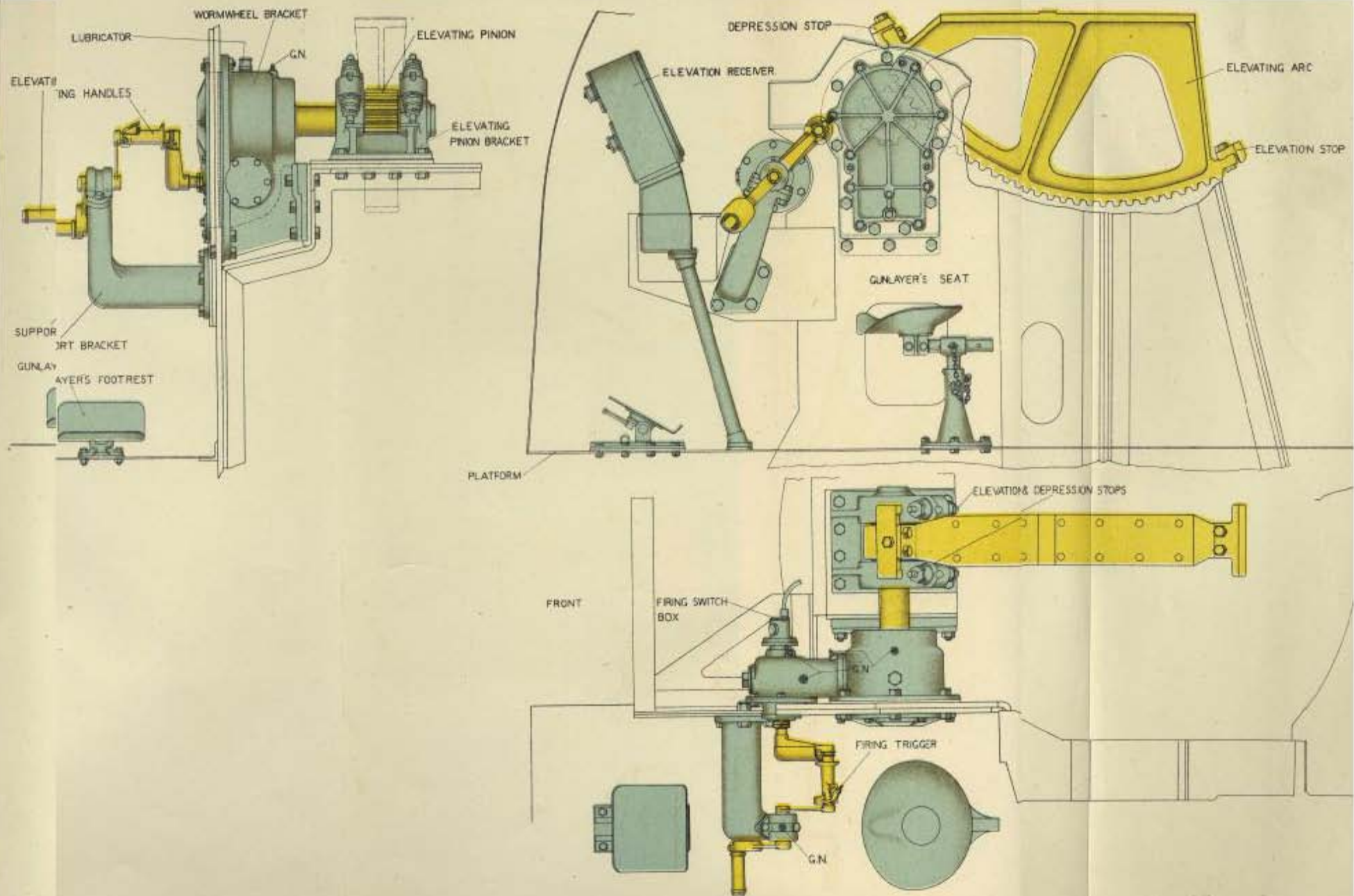
4' HA. MARK XIX MOUNTINGS  
ASSEMBLY OF REAR LINKS.



4" H.A. MARK XX. MOUNTINGS  
ASSEMBLY OF REAR LINKS.



# ELEVATING GEAR-GENERAL ARRANGEMENT

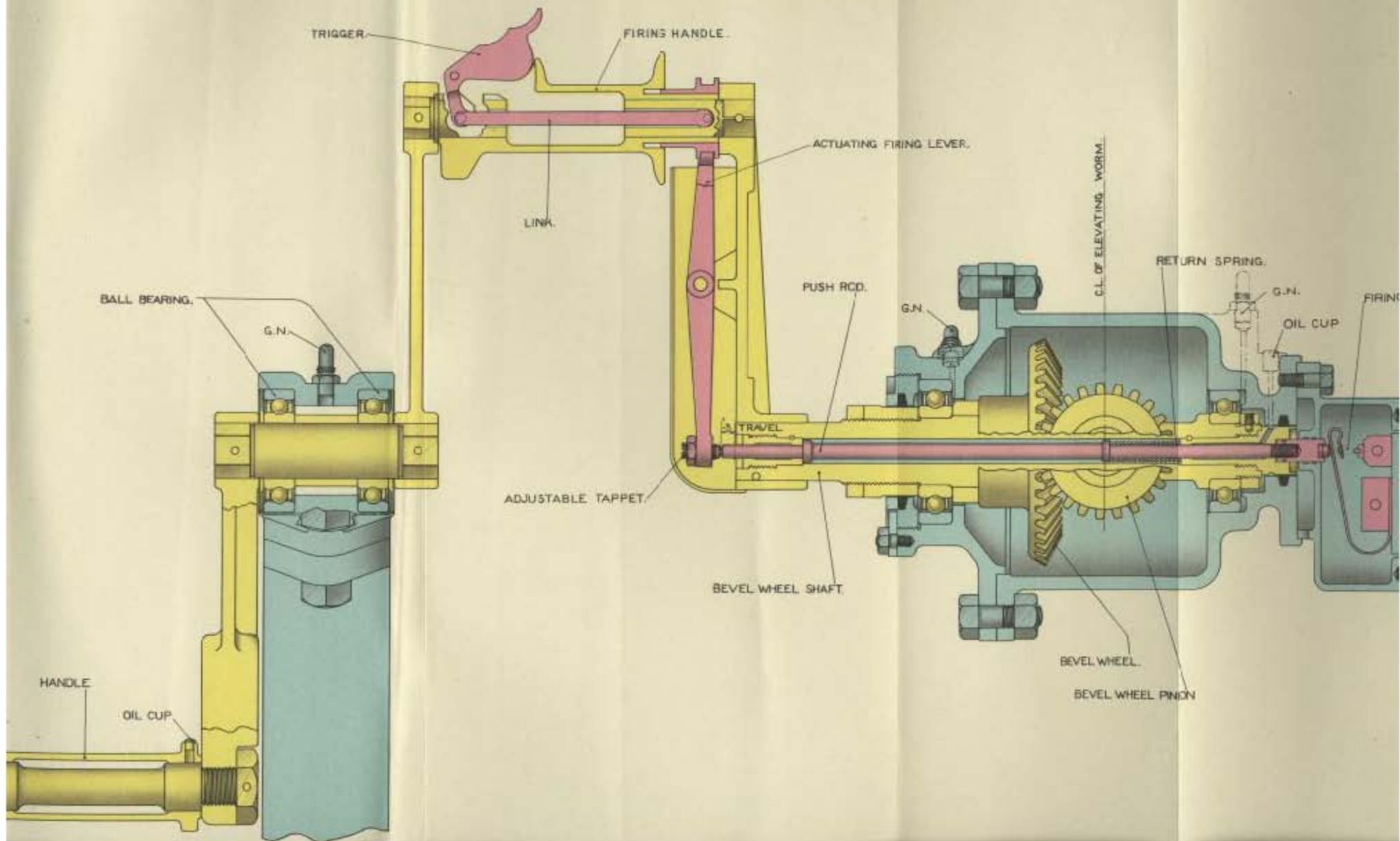


## NAME: \_\_\_\_\_

[illegible]

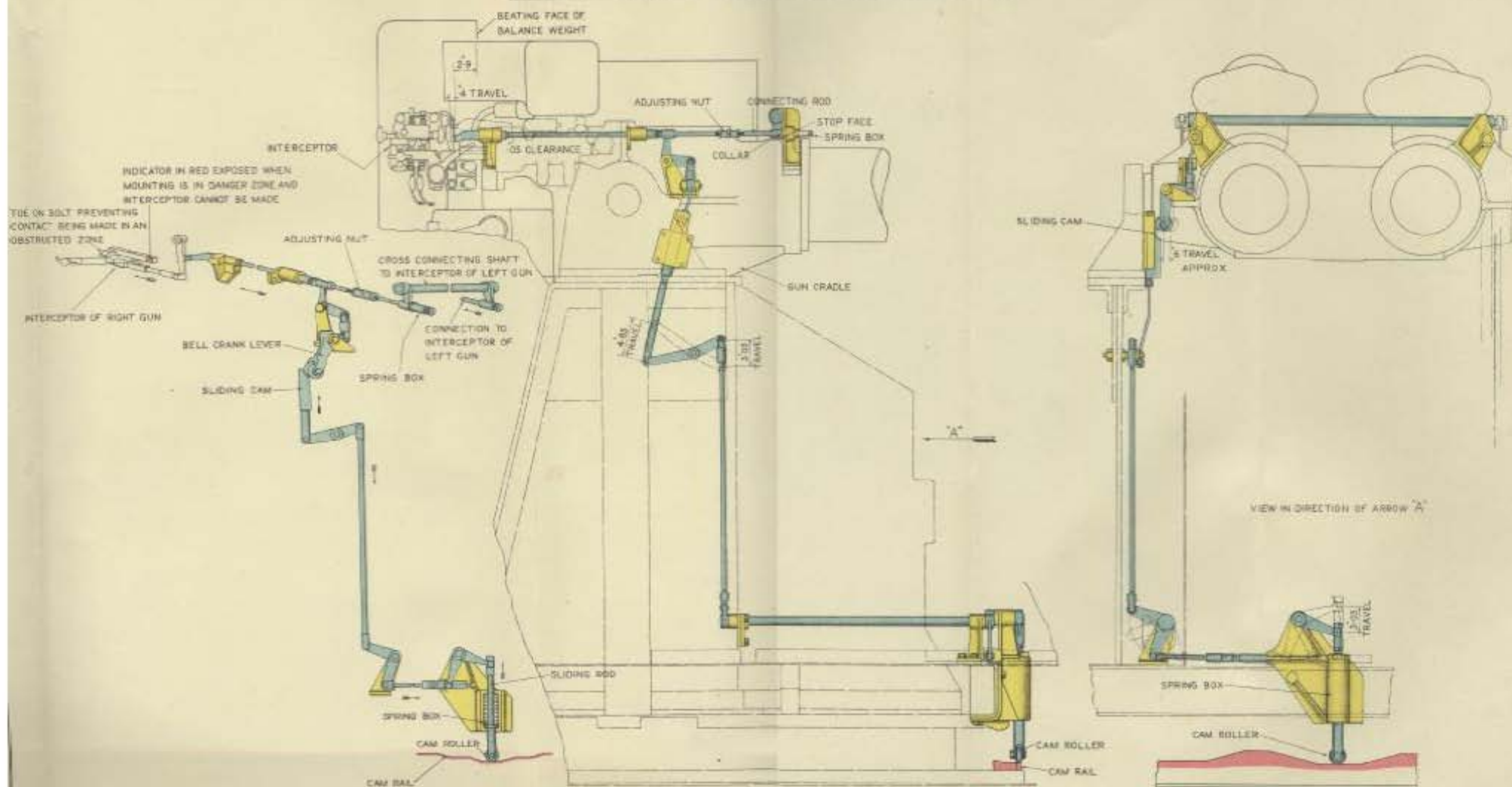


# GUNLAYER'S FIRING GEAR.



# SAFETY FIRING GEAR-MARK XIX MTG.

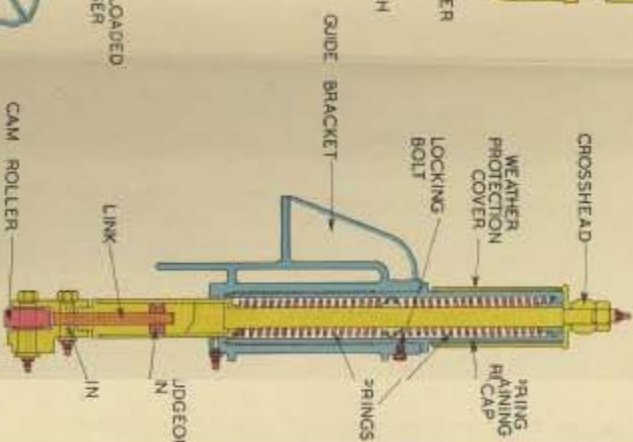
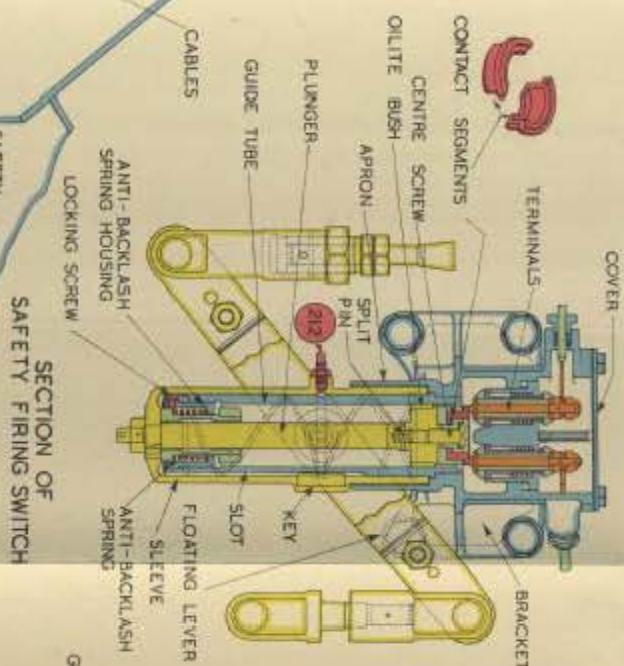
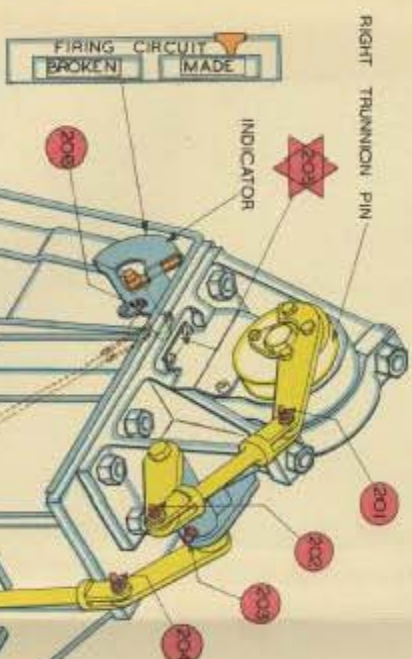
PLATE 24





# SAFETY FIRING SWITCH AND OPERATING GEAR.

## EXPANDED VIEW OF INDICATOR QUADRANT



REFERENCE OF LUBRICATOR	FREQUENCY OF LUBRICATION
RED	WEEKLY

SYMBOLS  
ENOTS GREASE GUN NIPPLES  
SPRINGWELL OIL CUPS



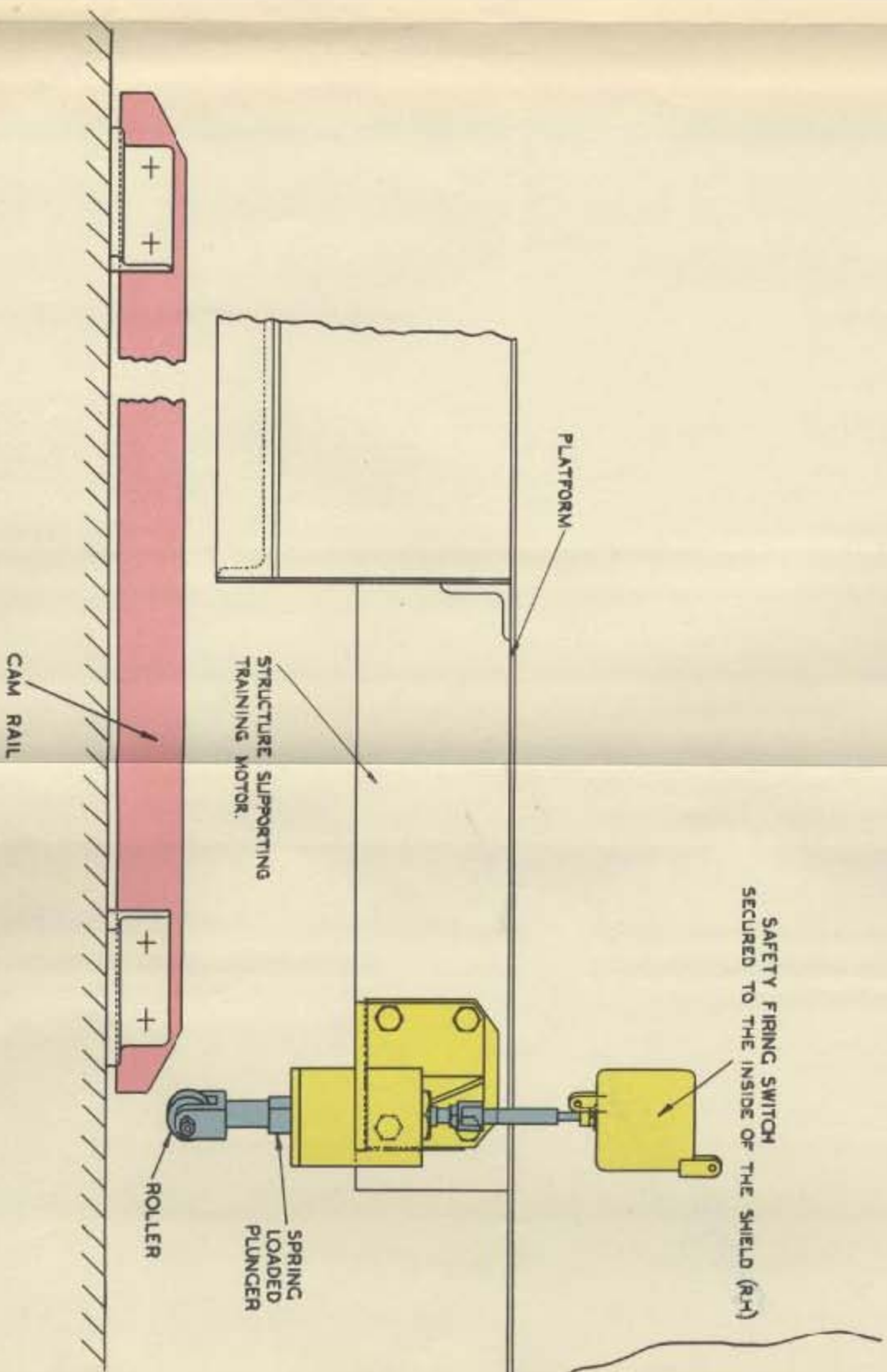
ON OPPOSITE TRUNNION PIN



Plate 24A. Bottom left. After "ENOTS GREASE GUN NIPPLES" and "SPRINGWELL OIL CUPS" standard types supplied. Mounting reconditioned and/or converted from 1940 onwards are fitted with standard nipples.

2 INCH ROCKET FLARE LAUNCHER.  
SAFETY FIRING GEAR.

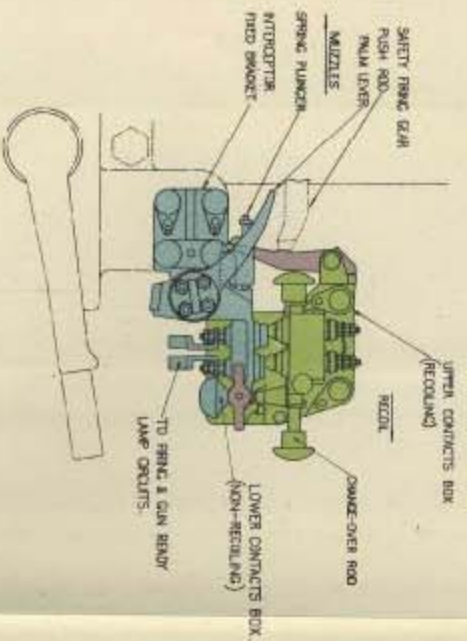
Plate :



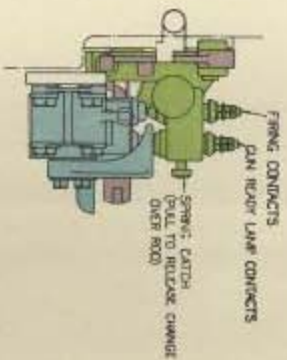


# THE INTERCEPTOR.

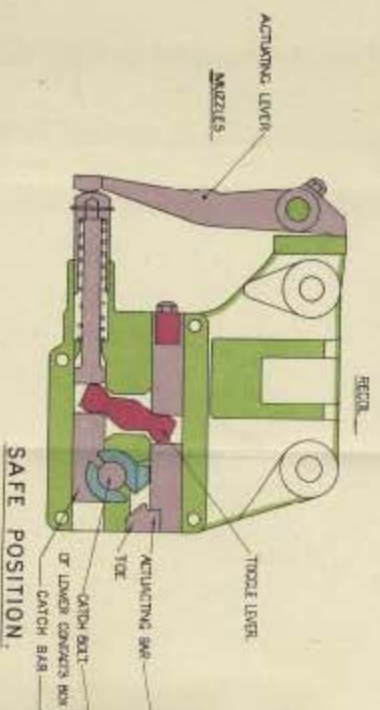
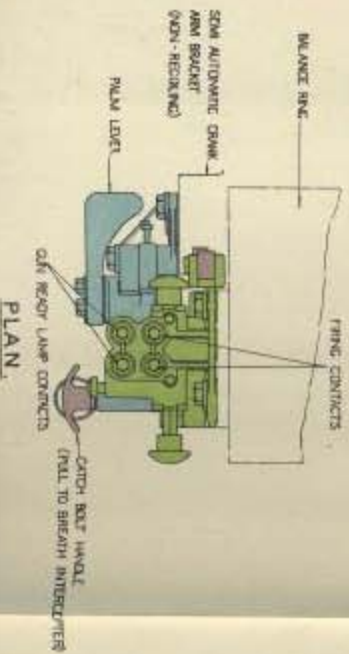
PLATE 25



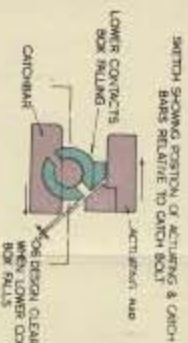
ELEVATION.



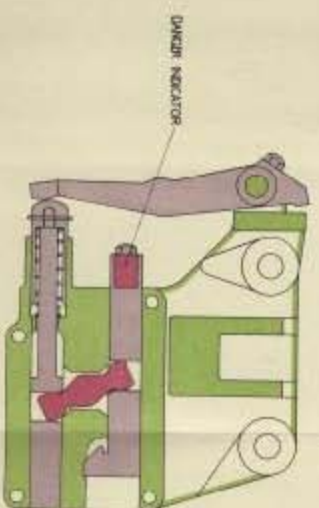
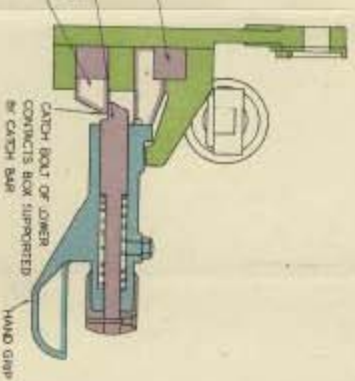
SIDE VIEW.



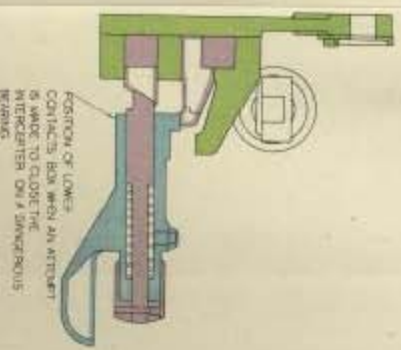
SAFE POSITION.



INTERCEPTOR BREAKING.



DANGER POSITION.

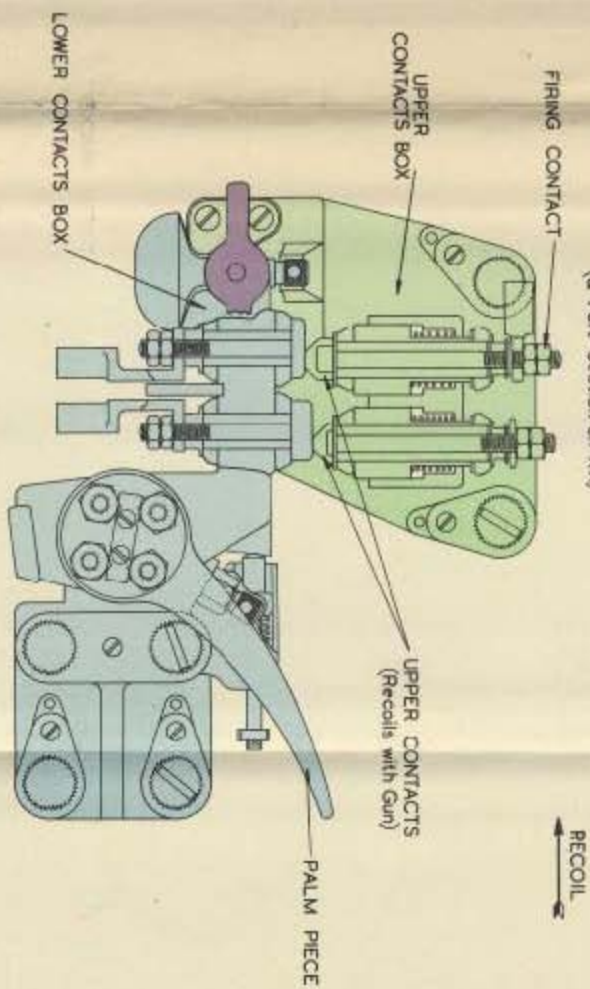


ATTEMPTING TO MAKE

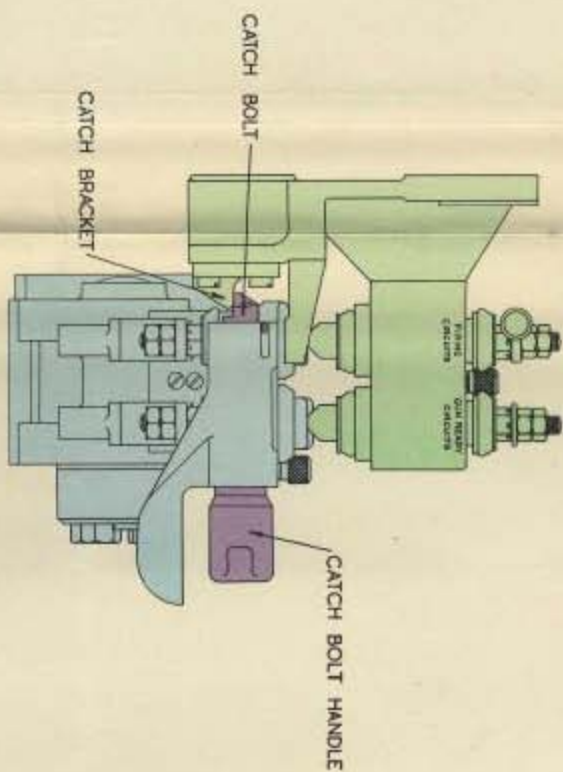
# INTERCEPTOR MARK 6.

PLATE 25A

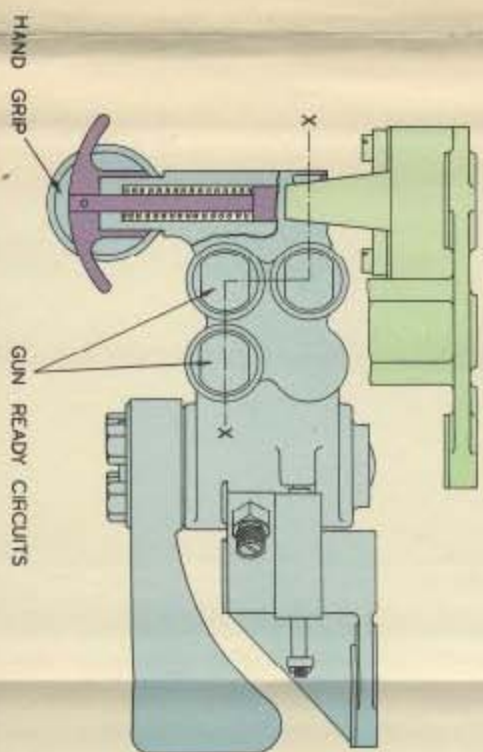
FRONT ELEVATION  
(& Part Section on XX)



SIDE VIEW

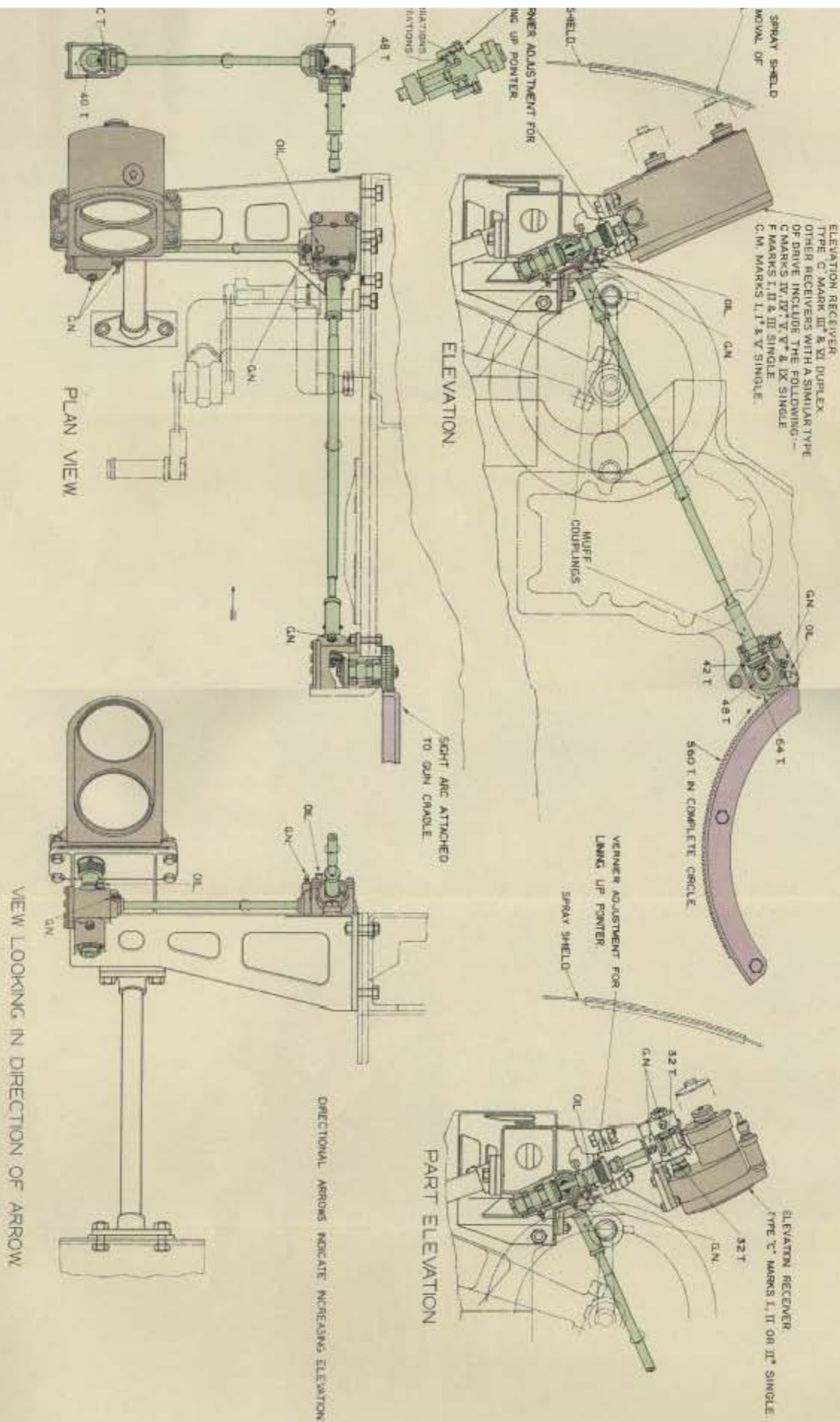


PLAN



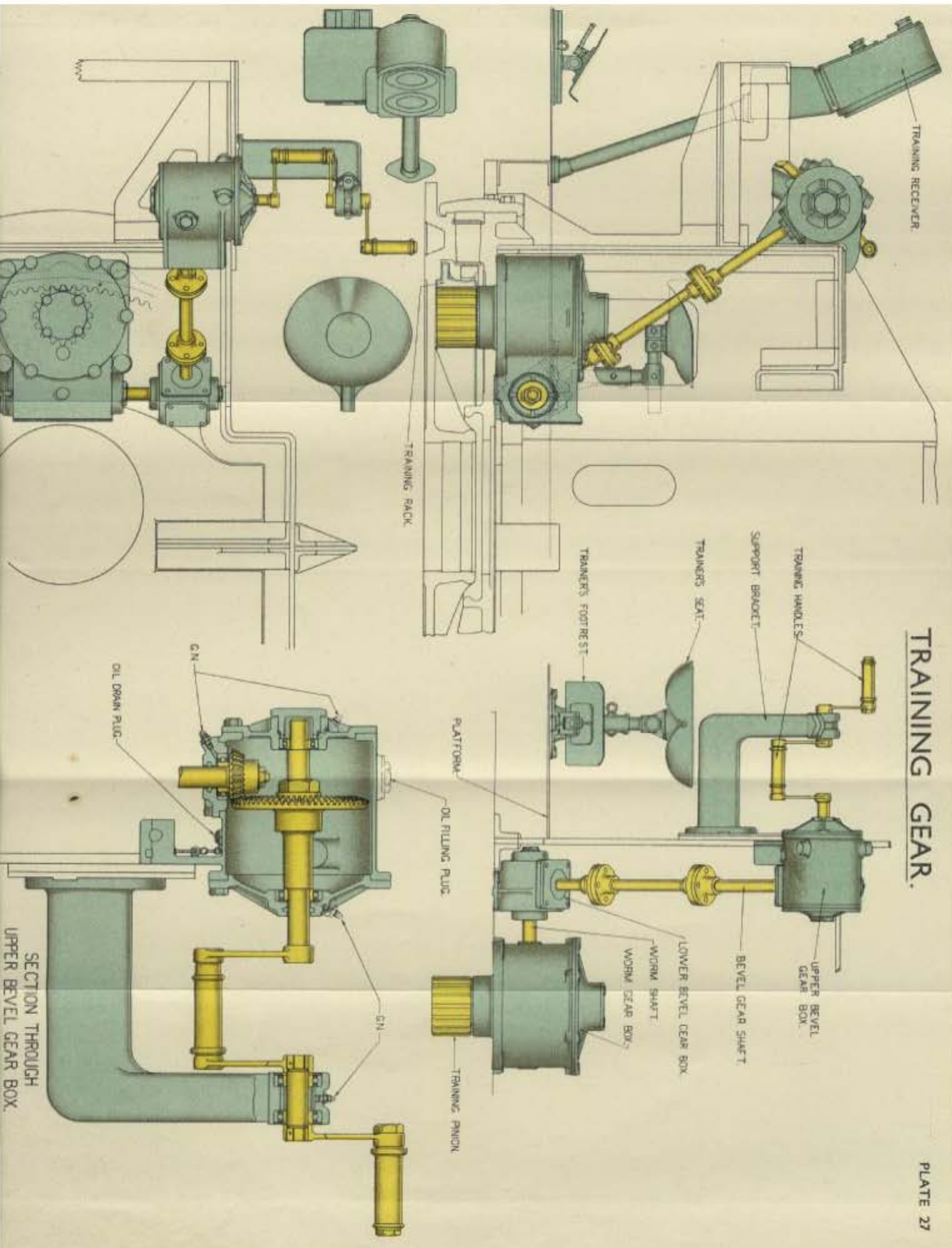


## ELEVATION RECEIVER - MECHANICAL POINTER DRIVE.



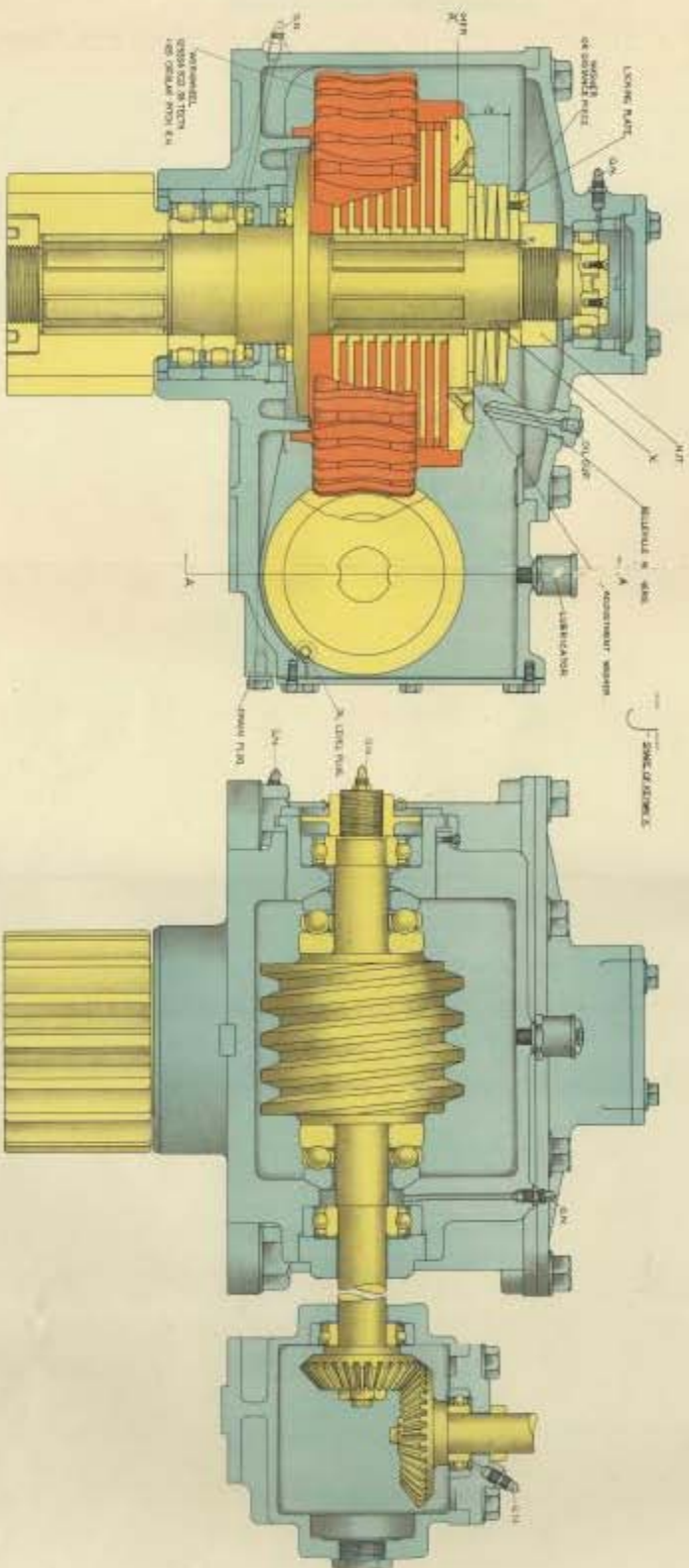
# TRAINING GEAR.

PLATE 27



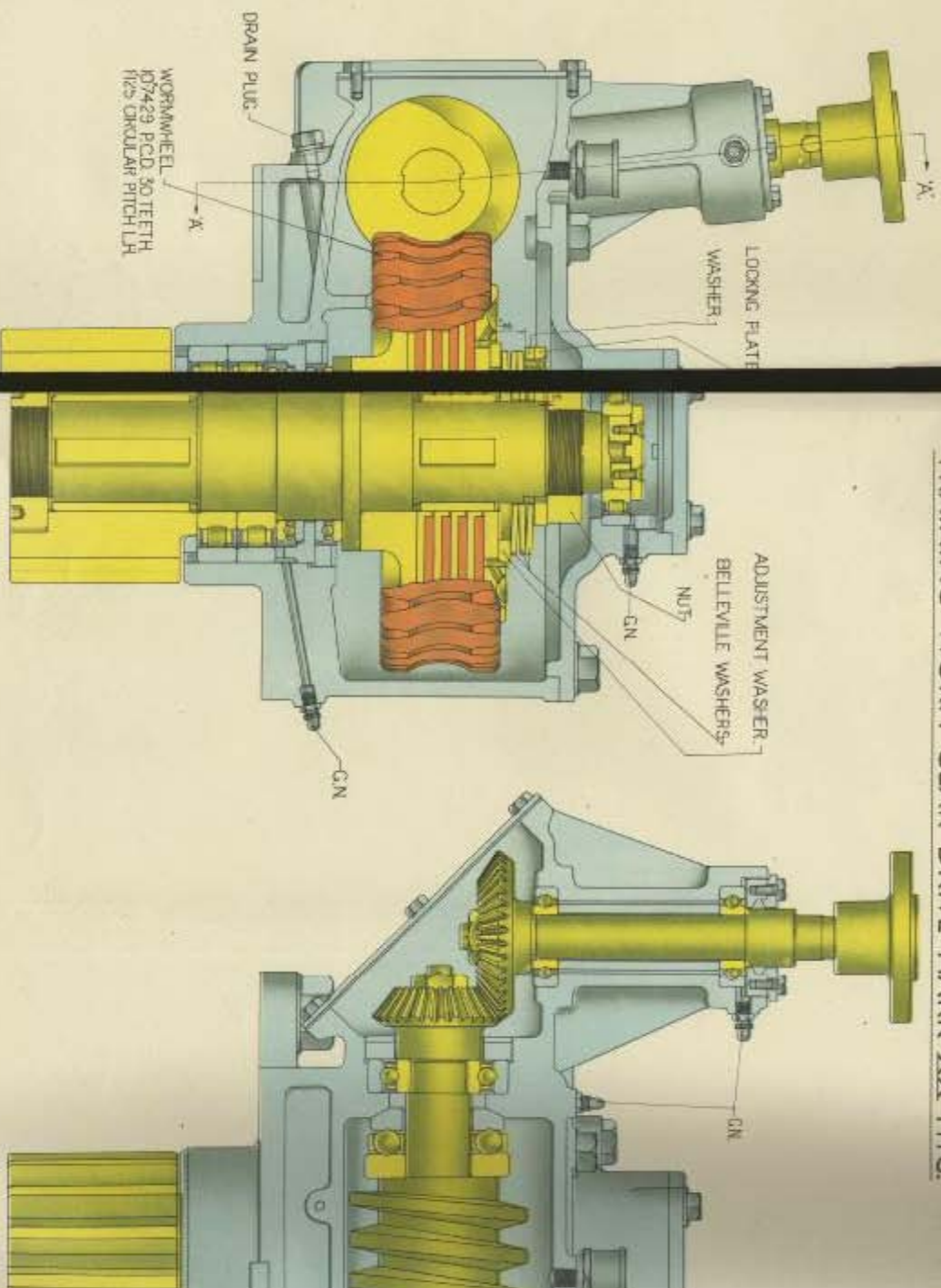


# TRAINING WORM GEAR DRIVE-MARK XIX MTG.



SECTION AT AA  
 SECTION AT BB  
 SECTION AT CC  
 SECTION AT DD  
 SECTION AT EE  
 SECTION AT FF  
 SECTION AT GG  
 SECTION AT HH  
 SECTION AT II  
 SECTION AT JJ  
 SECTION AT KK  
 SECTION AT LL  
 SECTION AT MM  
 SECTION AT NN  
 SECTION AT OO  
 SECTION AT PP  
 SECTION AT QQ  
 SECTION AT RR  
 SECTION AT SS  
 SECTION AT TT  
 SECTION AT UU  
 SECTION AT VV  
 SECTION AT WW  
 SECTION AT XX  
 SECTION AT YY  
 SECTION AT ZZ

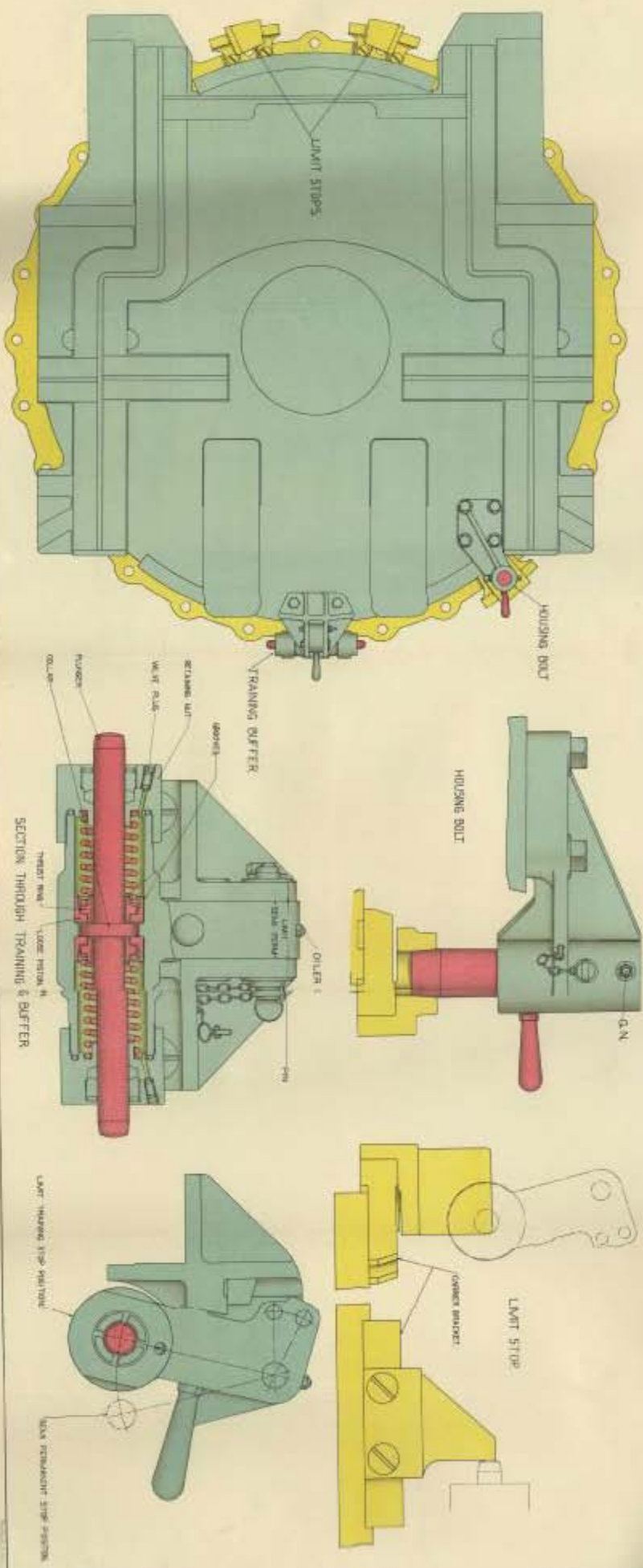
# TRAINING WORM GEAR DRIVE-MARK XX MTG.



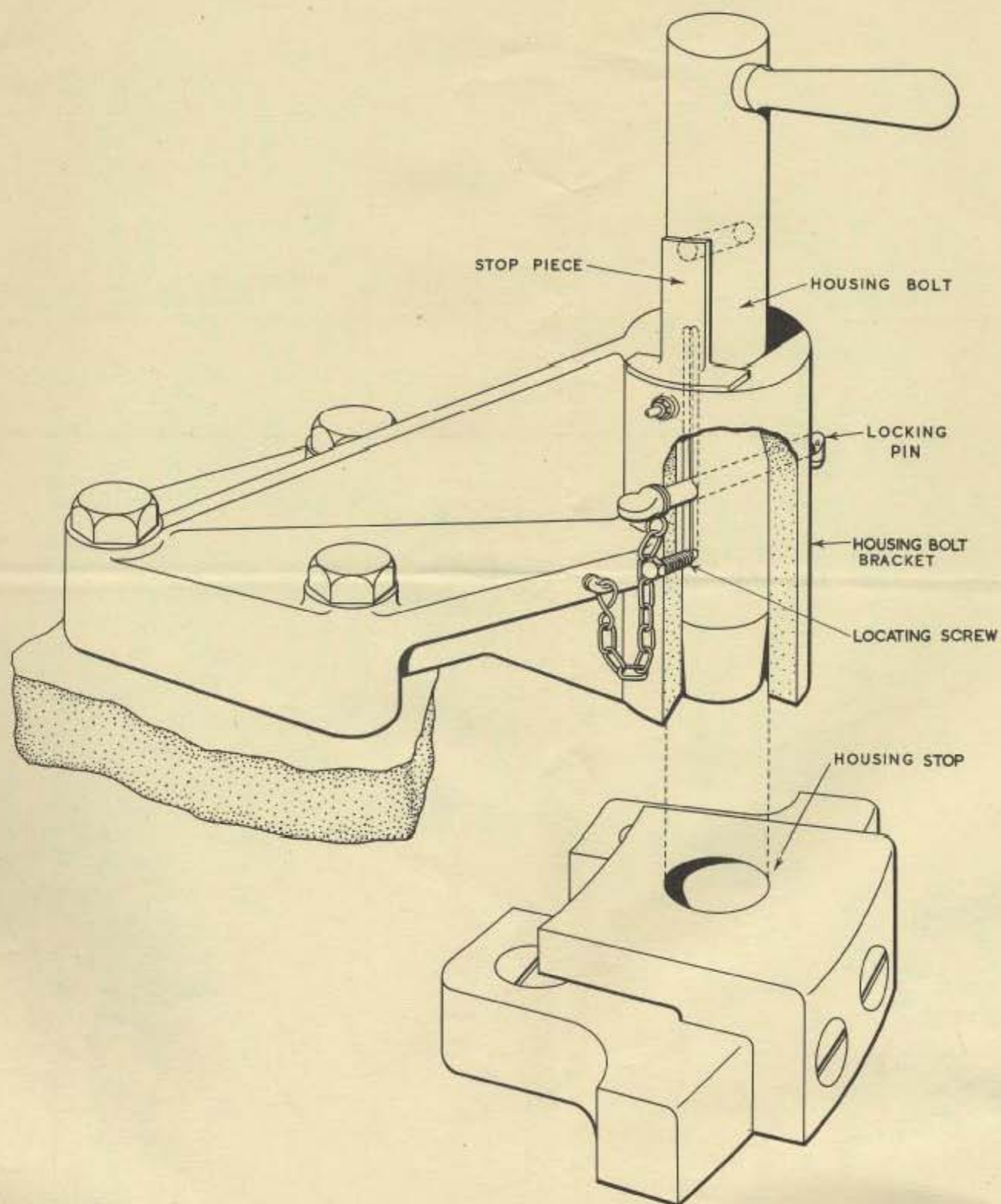
INSTRUCTIONS FOR ASSEMBLING BELLEVILLE WASHERS.  
NUT TO BE SCREWED UP UNTIL DIMENSION "E"  $\pm .005$  IN. AND NUT AND SHAFT MARKED THE MARK ON SHAFT TO BE 180° FROM CENTRE OF KEYWAY FOR WASHER.  
REMOVE NUT AND INSERT RING GAUGE .014 IN. LONG ON SHAFT AND ADJUST THICKNESS OF WASHER SO THAT WHEN NUT IS SCREWED HARD UP THE MARKS ARE IN LINE.  
REMOVE RING GAUGE AND SUBSTITUTE SET OF BELLEVILLE WASHERS AND ADJUSTMENT WASHER, THEN FINALLY SCREW UP UNTIL MARKS ARE IN LINE.  
LOCK IN POSITION WITH LOCKING PLATE.



# TRAINING BUFFER, TRAINING LIMIT STOPS AND HOUSING LOCKING BOLT.



# TRAINING HOUSING STOP

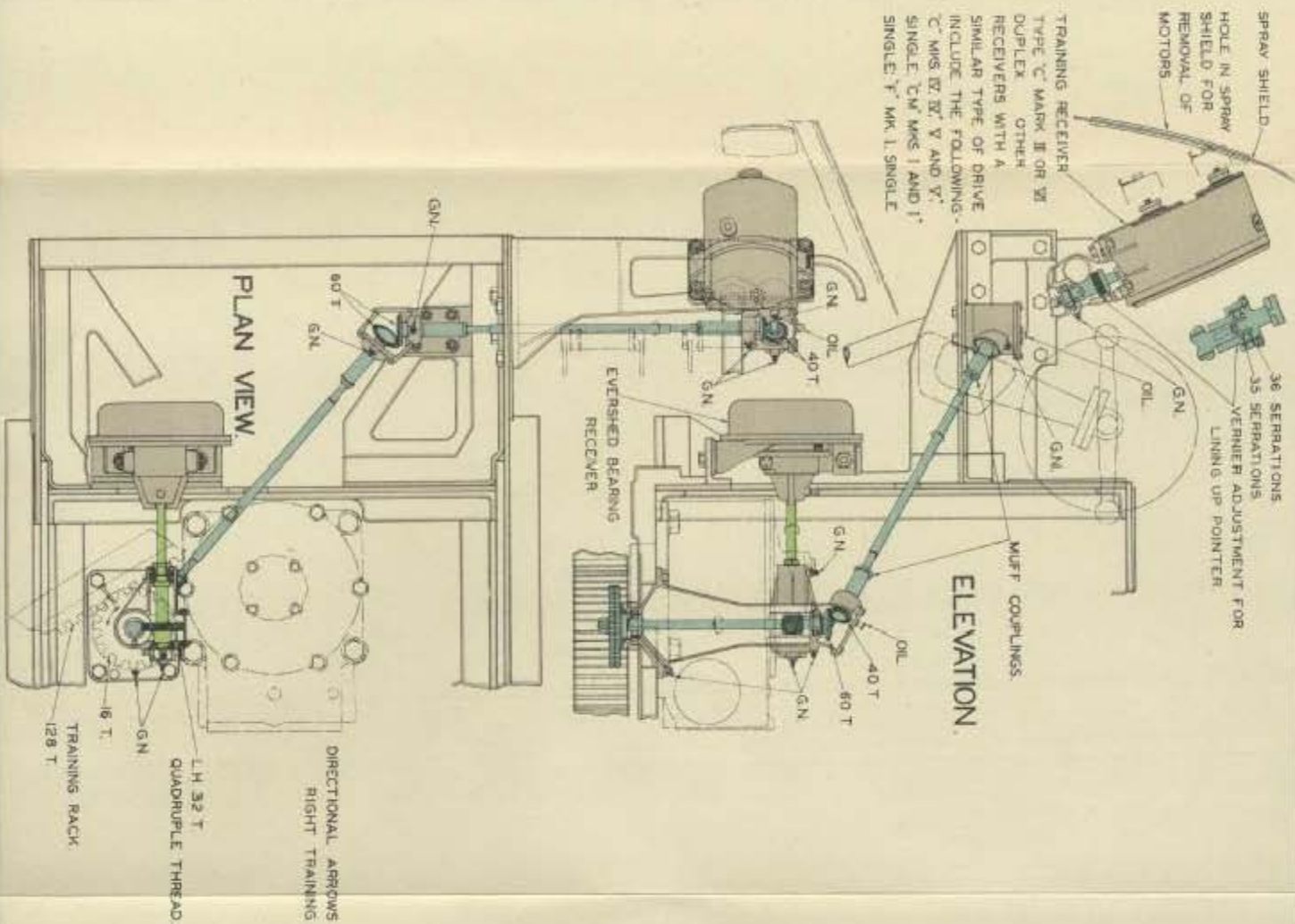




# TRAINING RECEIVER — MECHANICAL POINTER DRIVE.

(SHOWN FOR MARK XIX — TYPICAL ALSO FOR MARK XX.)

PLATE 31



TRAINING RECEIVER  
TYPE 'C' MARK II OR V  
DUPLEX OR OTHER  
RECEIVERS WITH A  
SIMILAR TYPE OF DRIVE  
INCLUDE THE FOLLOWING:  
'C' MMS II, 'V' AND 'V'  
SINGLE, 'CM' MMS I AND I'  
SINGLE, 'I' MMS I, SINGLE

SPRAY SHIELD  
HOLE IN SPRAY  
SHIELD FOR  
REMOVAL OF  
MOTORS

36 SERRATIONS  
35 SERRATIONS  
VERNIER ADJUSTMENT FOR  
LINING UP POINTER

MUFF COUPLINGS

ELEVATION

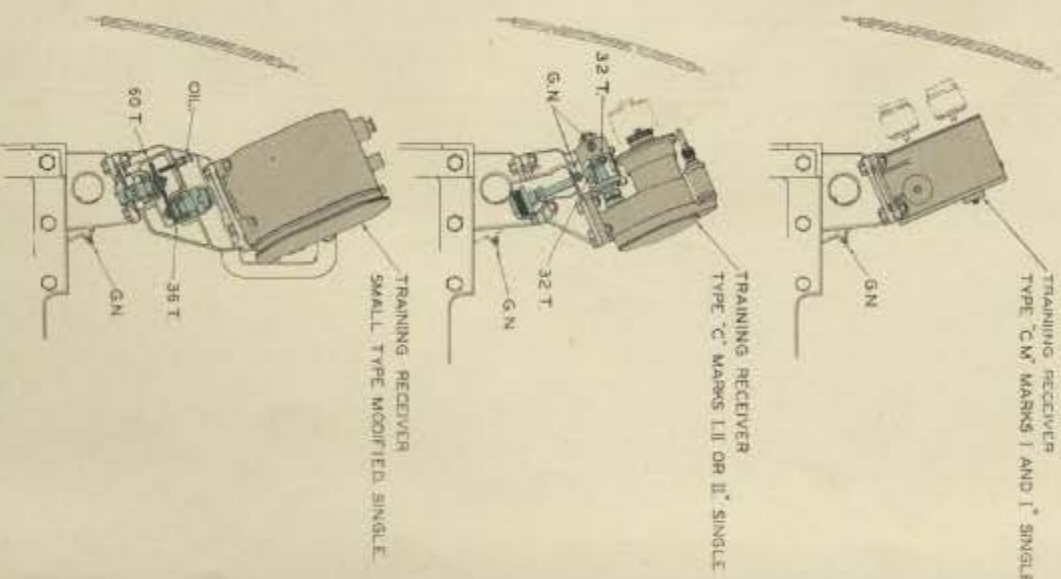
PLAN VIEW

DIRECTIONAL ARROWS INDICATE  
RIGHT TRAINING

L.H. 32 T  
QUADRUPLE THREAD

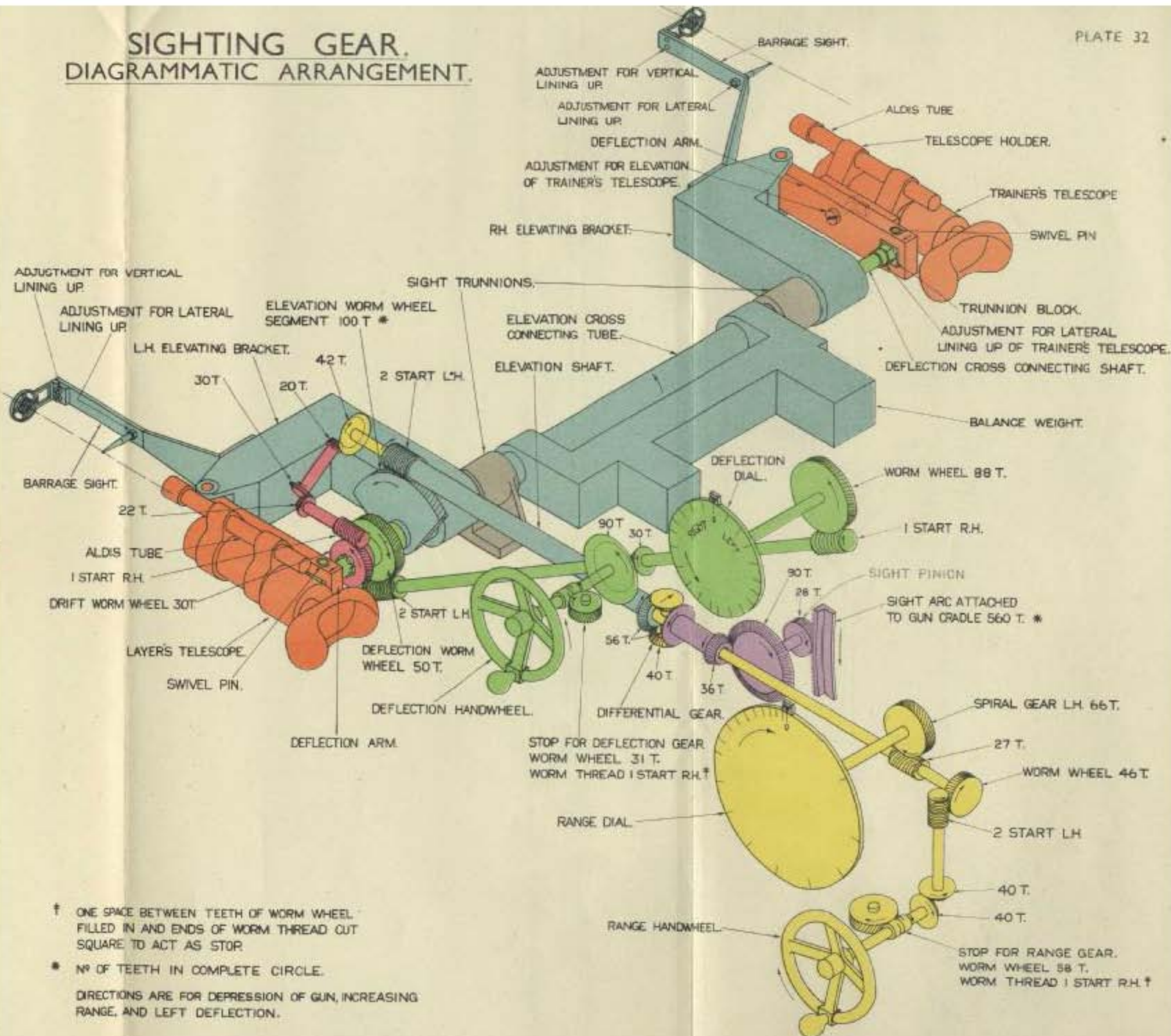
TRAINING RACK  
128 T

PART ELEVATIONS.



# SIGHTING GEAR. DIAGRAMMATIC ARRANGEMENT.

PLATE 32



† ONE SPACE BETWEEN TEETH OF WORM WHEEL FILLED IN AND ENDS OF WORM THREAD CUT SQUARE TO ACT AS STOP.

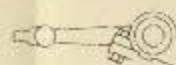
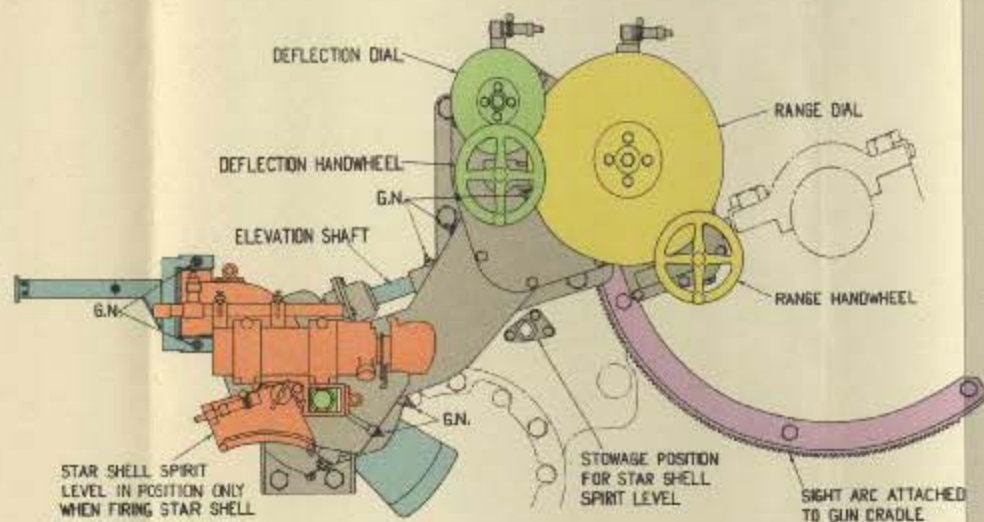
\* NO OF TEETH IN COMPLETE CIRCLE.

DIRECTIONS ARE FOR DEPRESSION OF GUN, INCREASING RANGE, AND LEFT DEFLECTION.

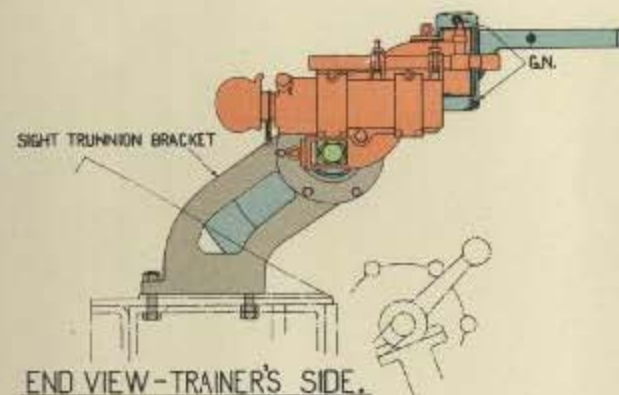


# SIGHTING GEAR GENERAL ARRANGEMENT.

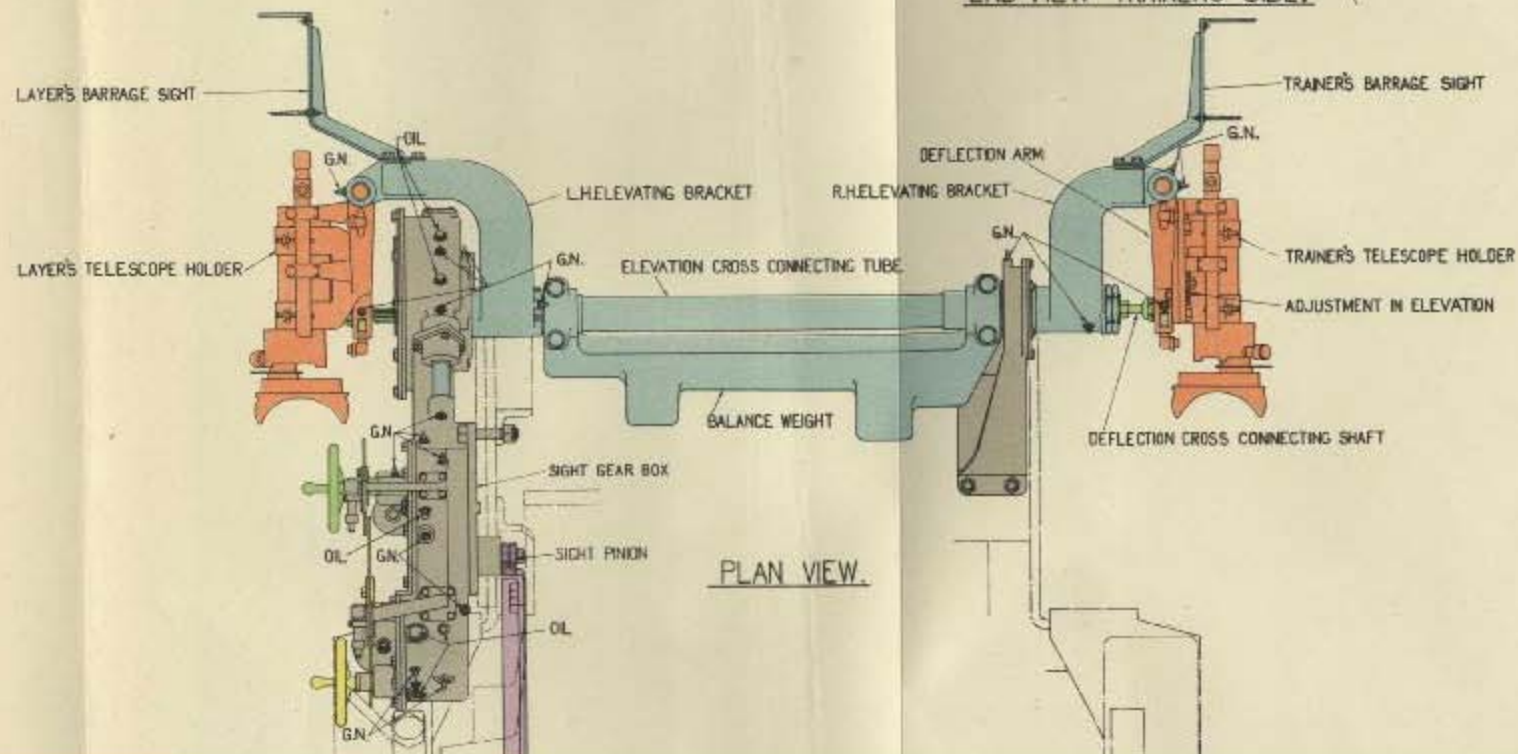
PLATE 33



END VIEW - LAYER'S SIDE.



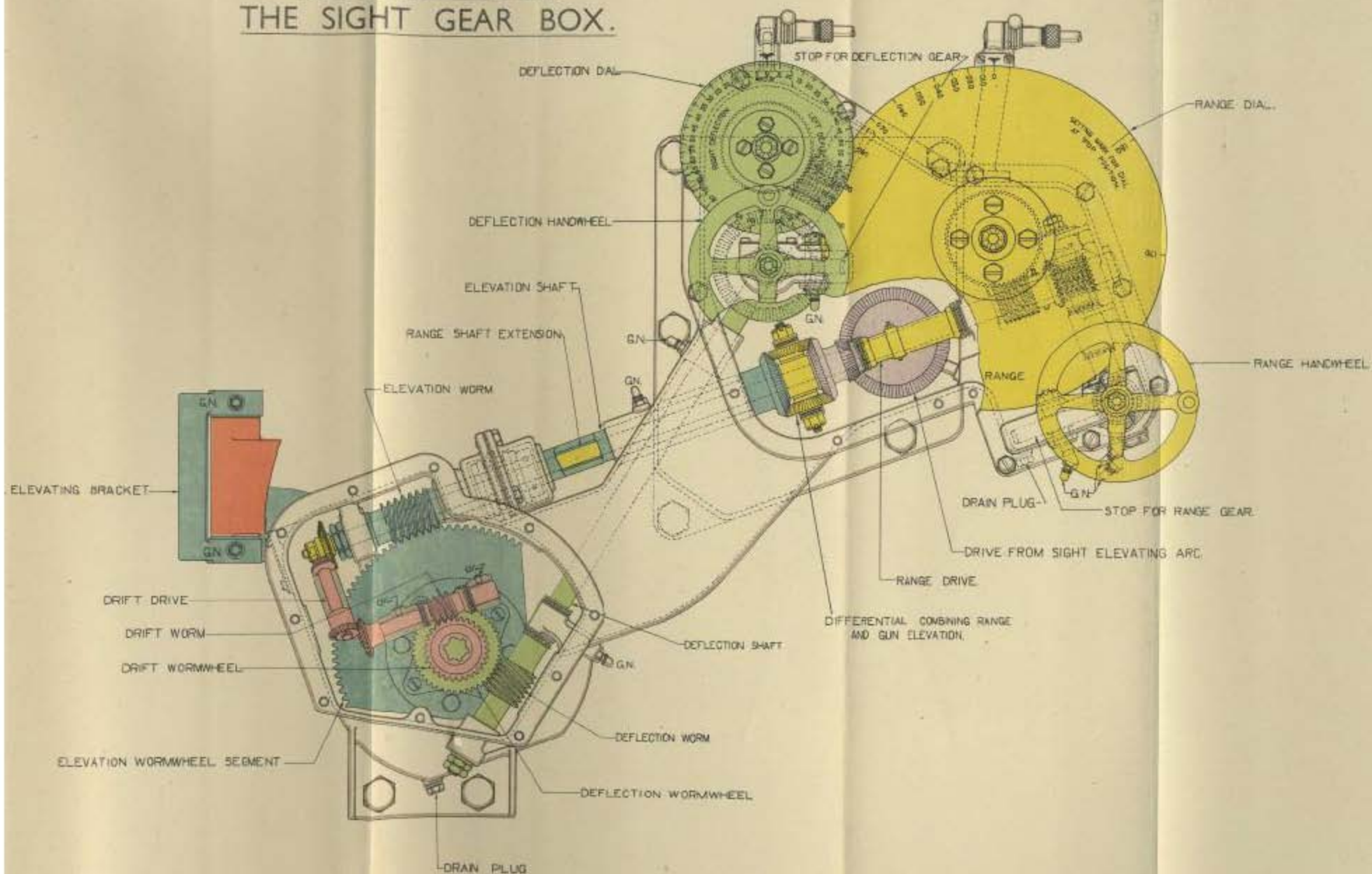
END VIEW - TRAINER'S SIDE.



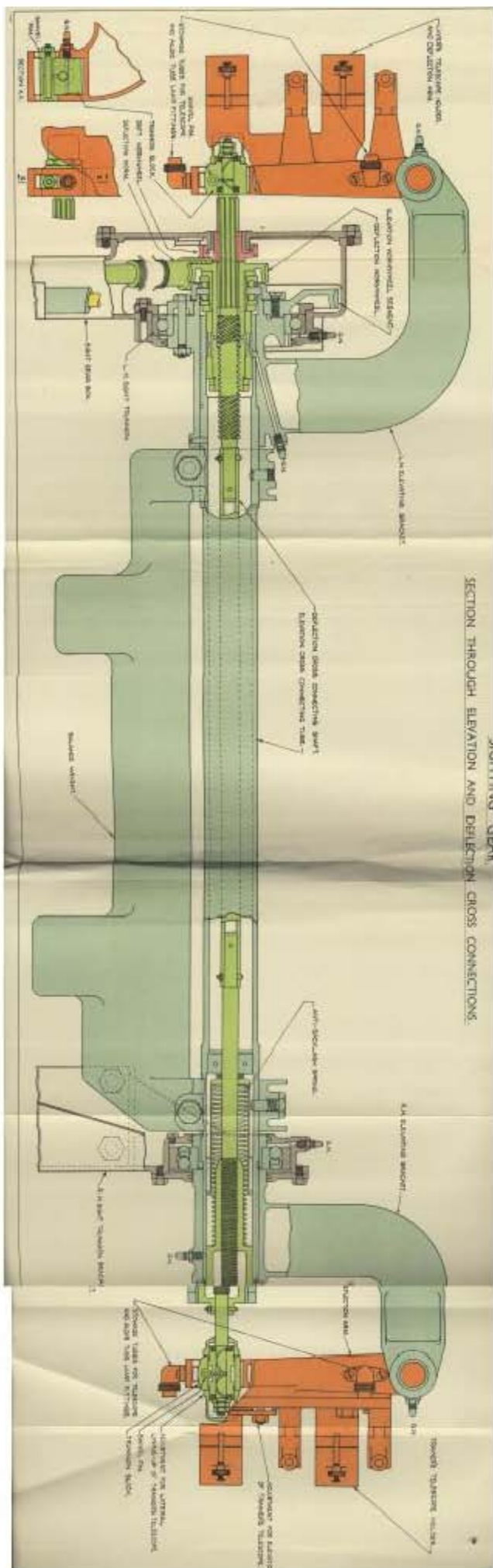
PLAN VIEW.

# SIGHTING GEAR. THE SIGHT GEAR BOX.

PLATE 34





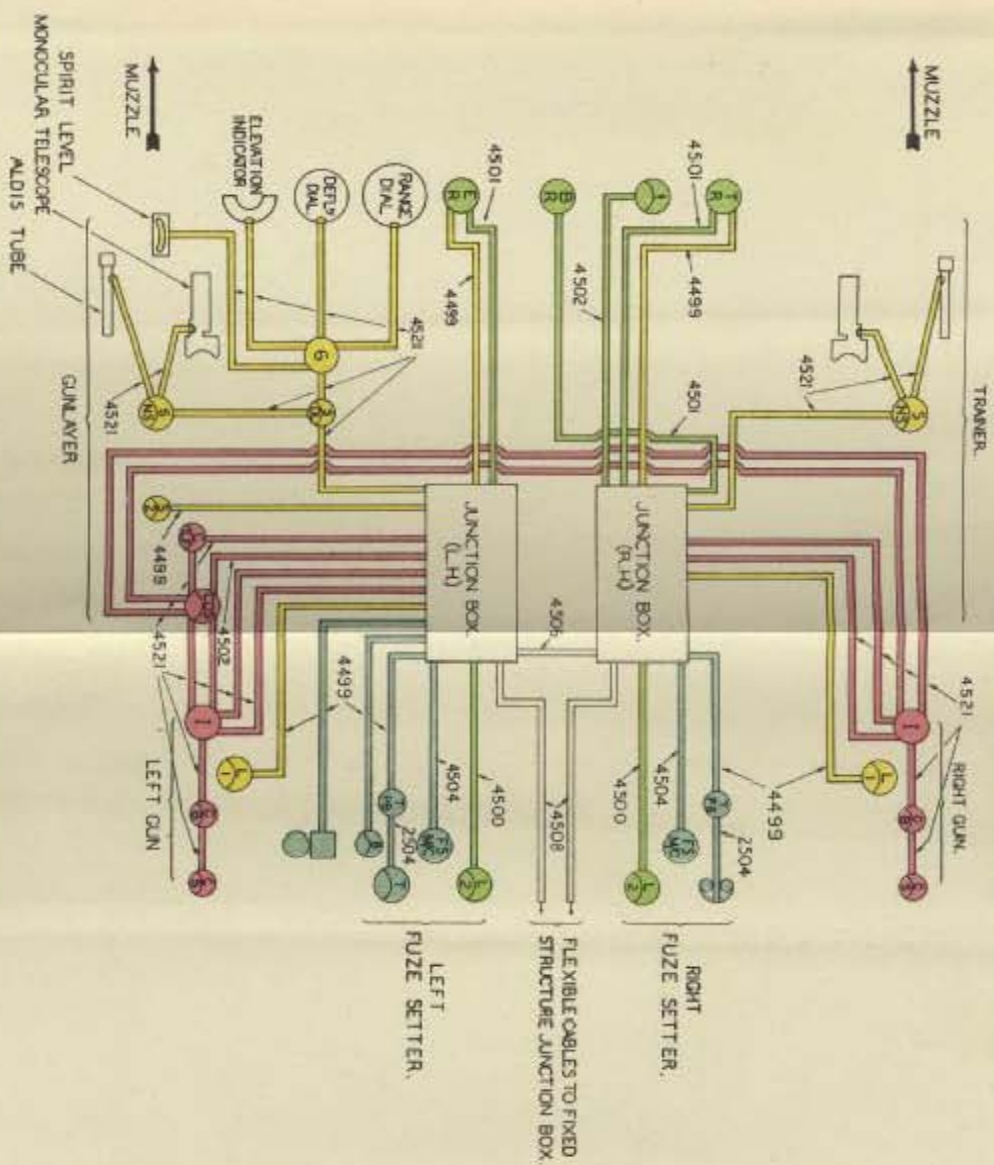


## DIAGRAMMATIC ARRANGEMENT OF CIRCUITS.

PLATE 36

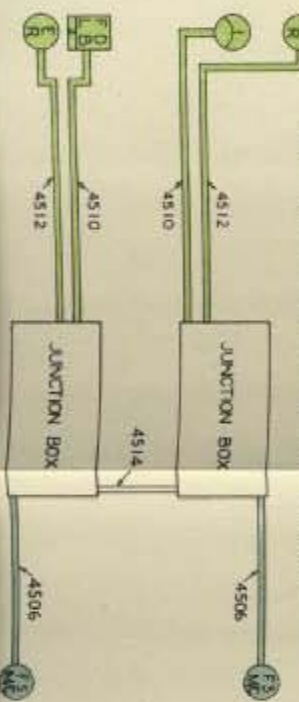
SINGLE H.A. CONTROL.

DRAWN FOR VESSELS WITH "M" TYPE TRANSMISSION



### MODIFICATIONS FOR DUPLICATE H.A. CONTROL

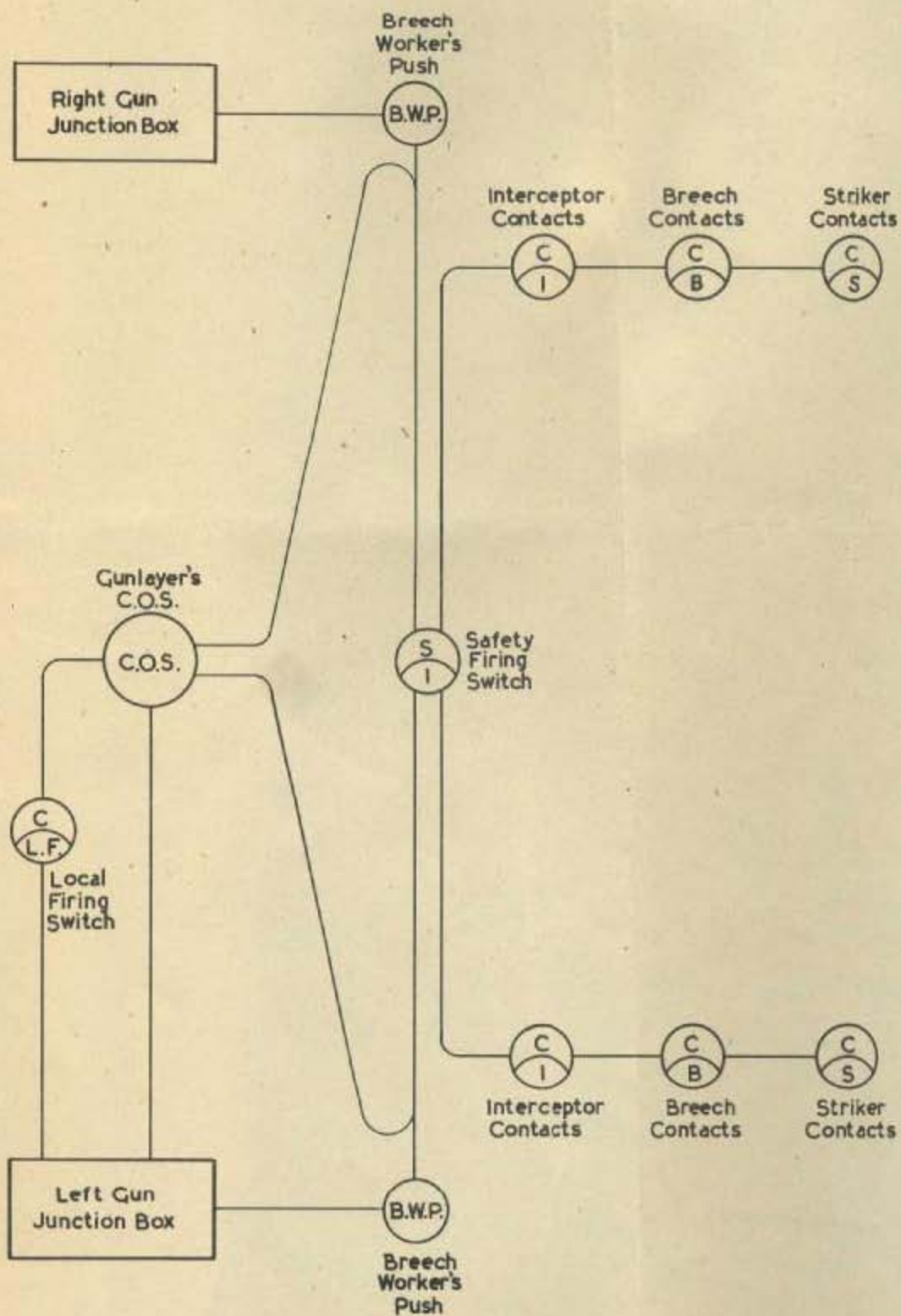
DRAWN FOR VESSELS WITH "M" TYPE TRANSMISSION.



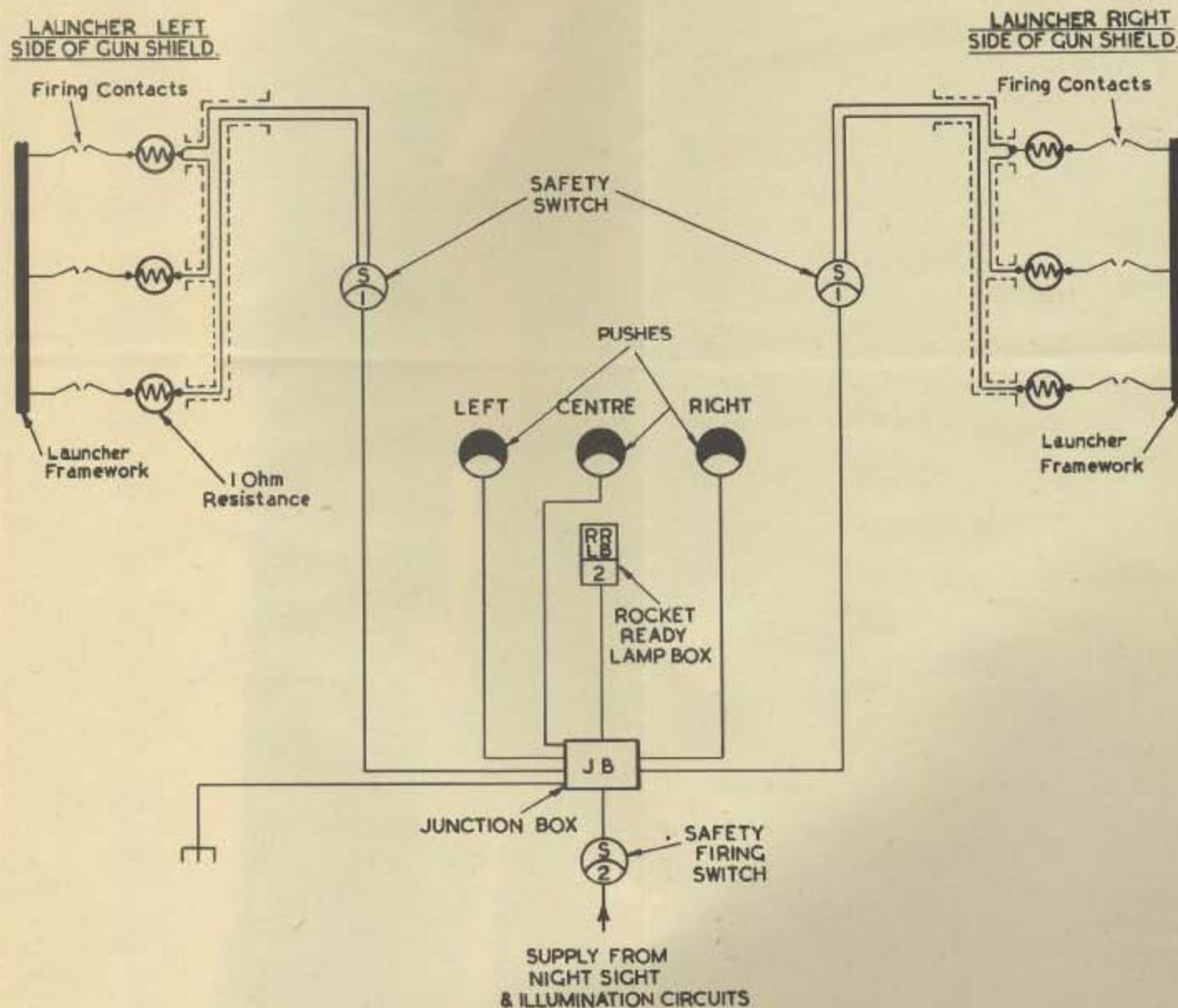
SYMBOL	DESCRIPTION
	TRAINING RECEIVER TYPE "C."
	ELEVATION RECEIVER TYPE "C."
	EVERSHED'S BEARING RECEIVER
	OPEN FACED INDICATOR
	FOLLOW DIRECTOR LAMP BOX
	BARRAGE INDICATOR LAMP BOX
	CUNILAYERS ORANGE-OVER-SWITCH
	INTERCEPTOR CONTACTS.
	LOCAL FIRING CONTACTS.
	BREECH CONTACTS.
	STRIKER CONTACTS.
	6 WAY CONNECTION BOX.
	LOADING LIGHT.
	NIGHT SIGHT SWITCH.
	DIAL LAMP SWITCH.
	S.P. SWITCH.
	TELEPHONE MARK II** OR MARK I.
	TELEPAD MARK I * * OR MARK II.
	FUZE SETTING MACHINE.
	TELEPHONE PLUG BOX.
	BUZZER.
	BELL, CHECK FIRE.



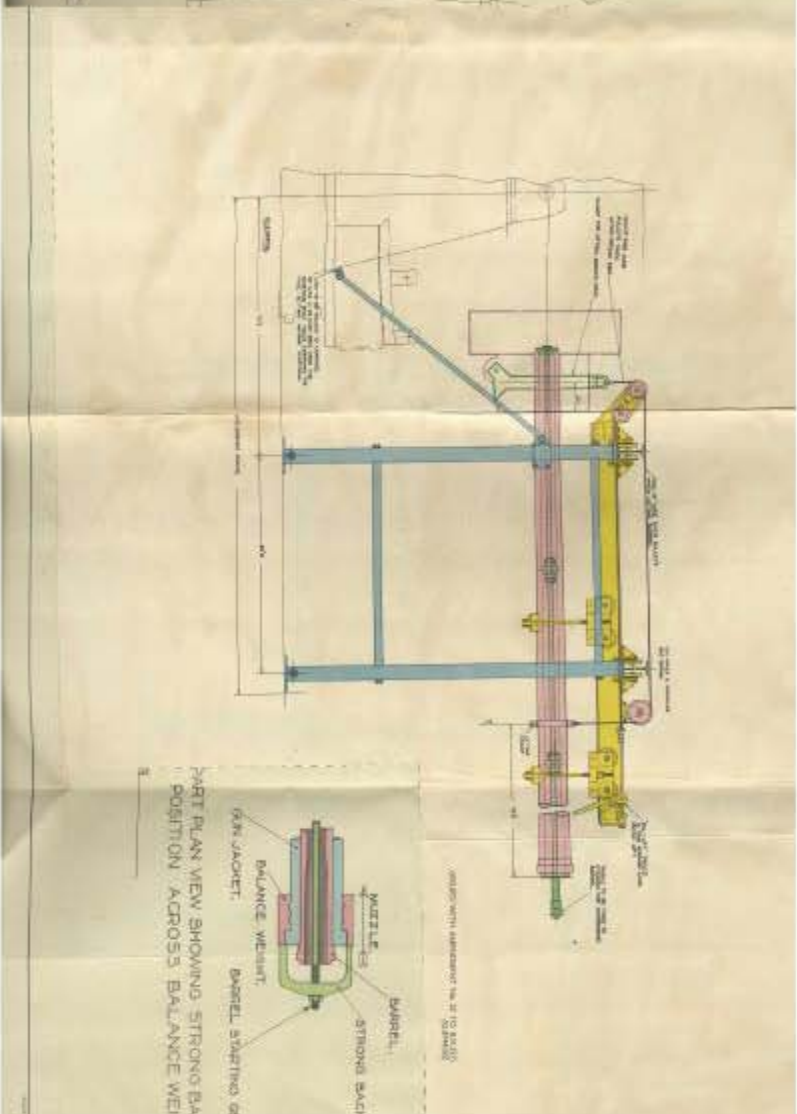
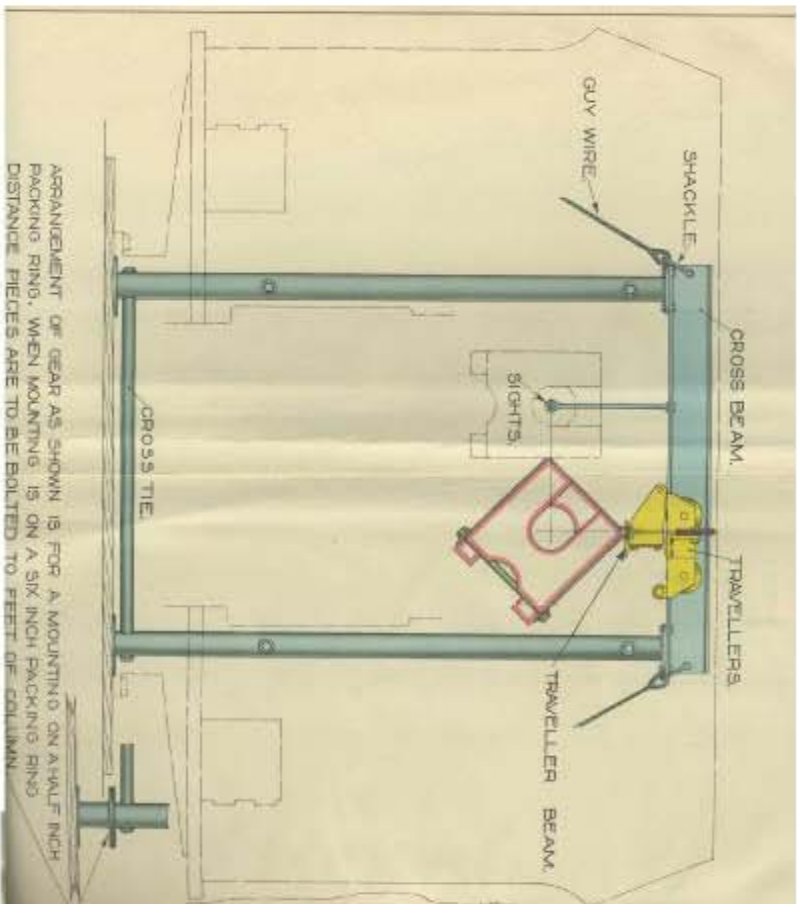
# DIAGRAMMATIC ARRANGEMENT OF FIRING CIRCUITS (when SAFETY FIRING SWITCH is fitted)

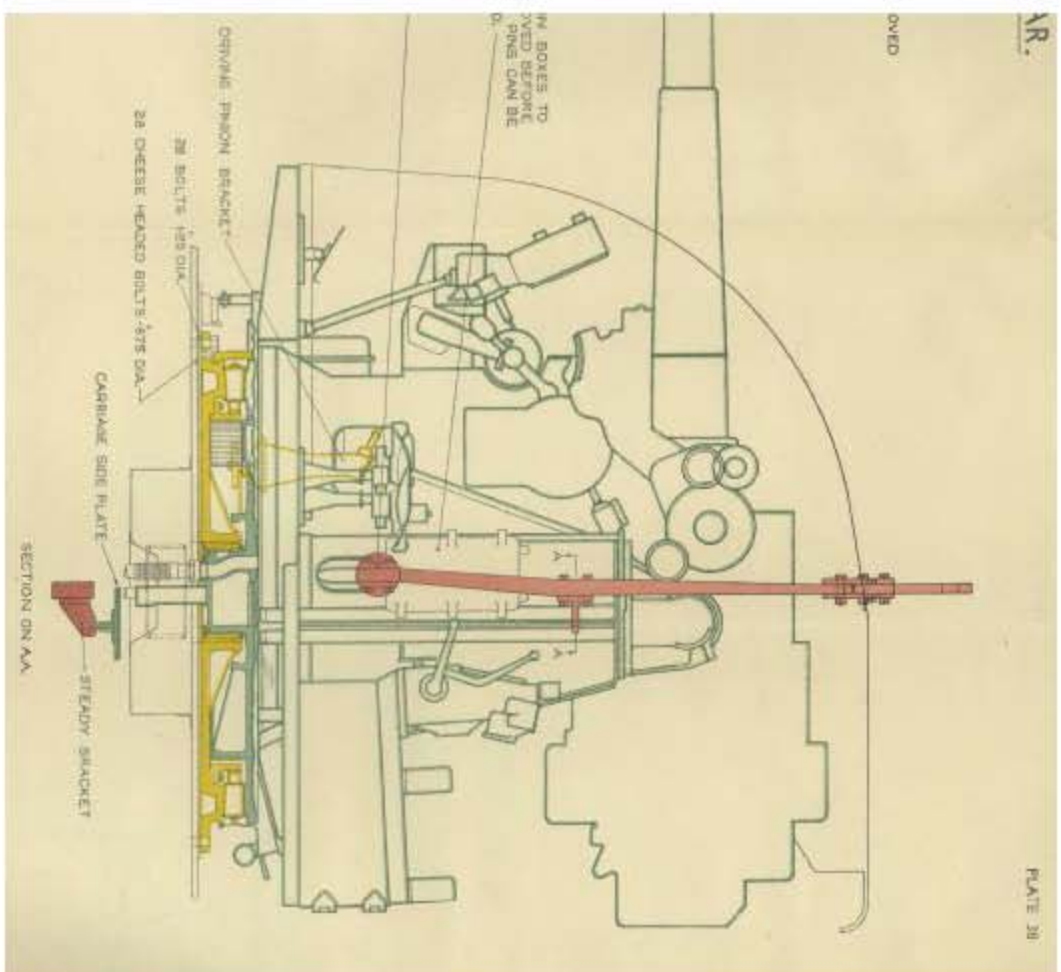
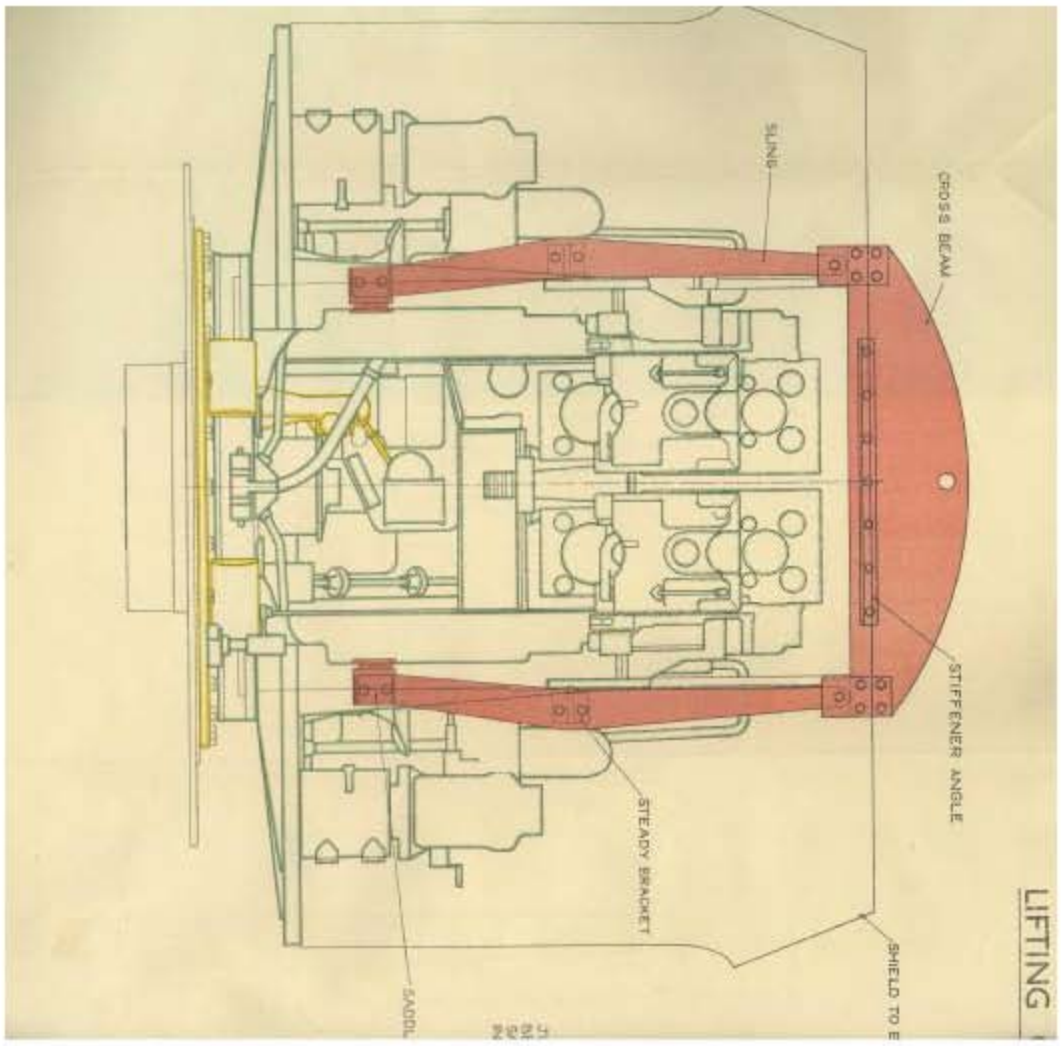


# 2 INCH ROCKET FLARE LAUNCHER. WIRING DIAGRAM.





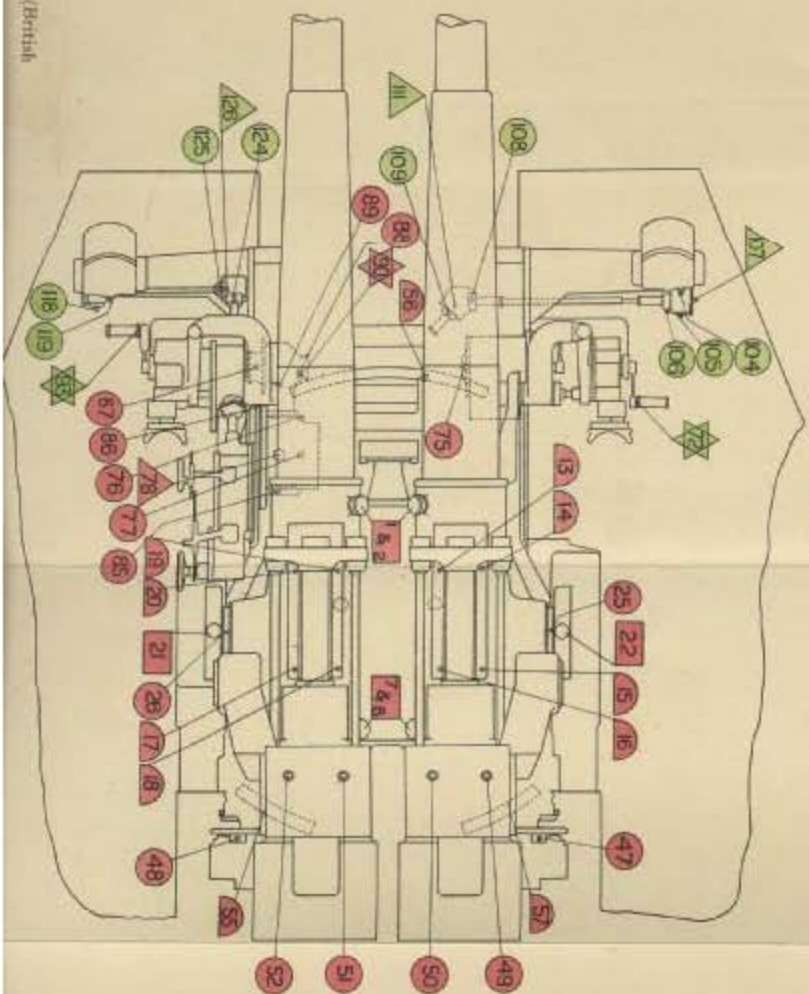
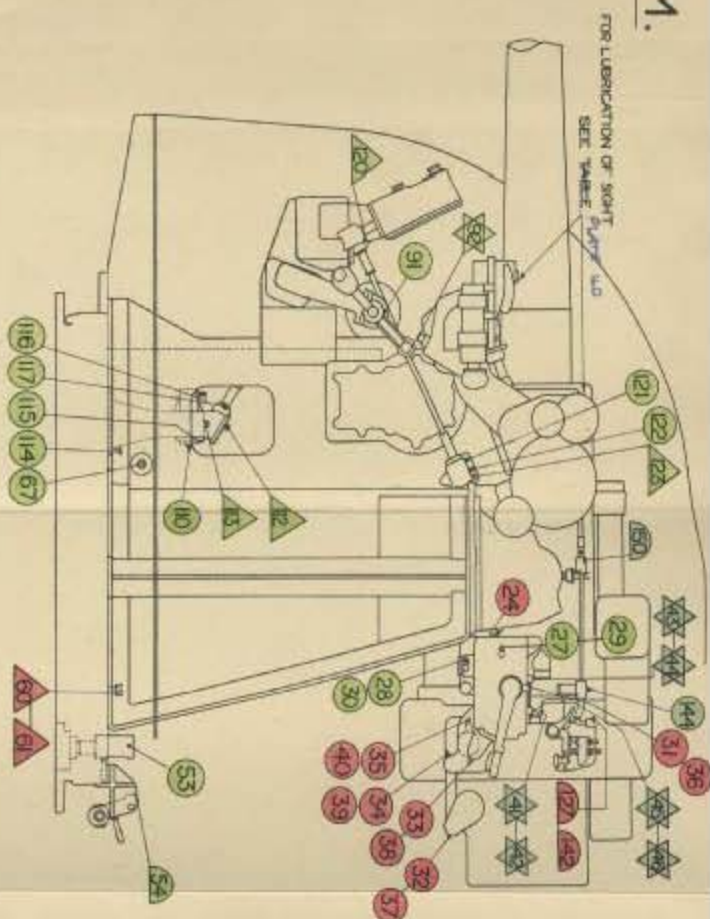
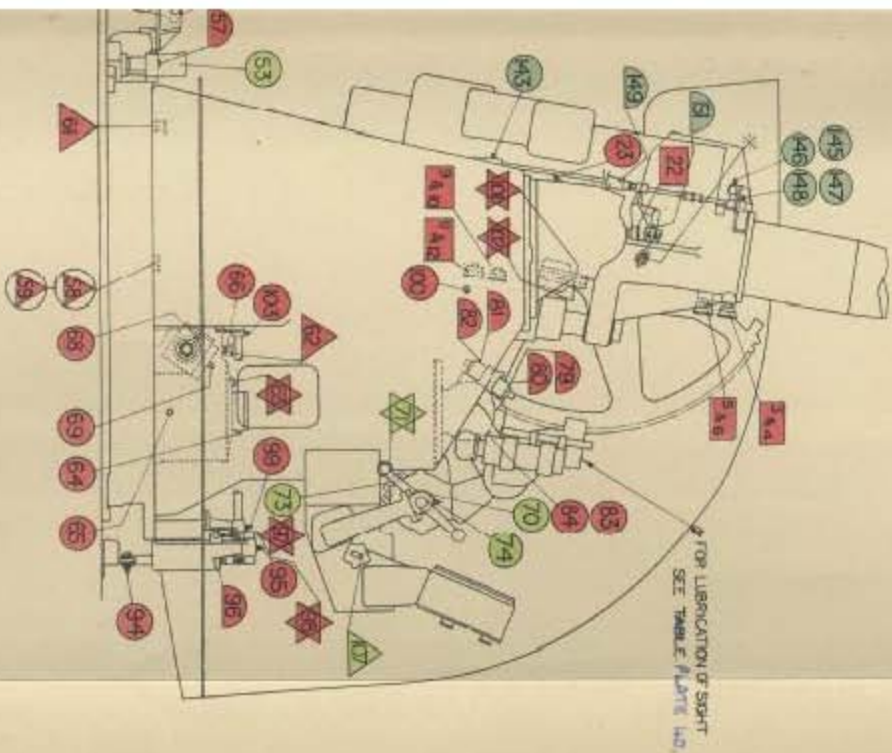






# LUBRICATING DIAGRAM.

PLATE 39



## SYMBOLS.

- STAUFFERS LUBRICATORS.
- TUCKERS OILERS.
- △ NOTS GREASE GUN NIPPLES.
- ◇ OTHERMAN LUBRICATORS.
- ▽ PRINCEWELL OIL CUPS.
- OIL HOLES.
- OIL LUBRICATORS.

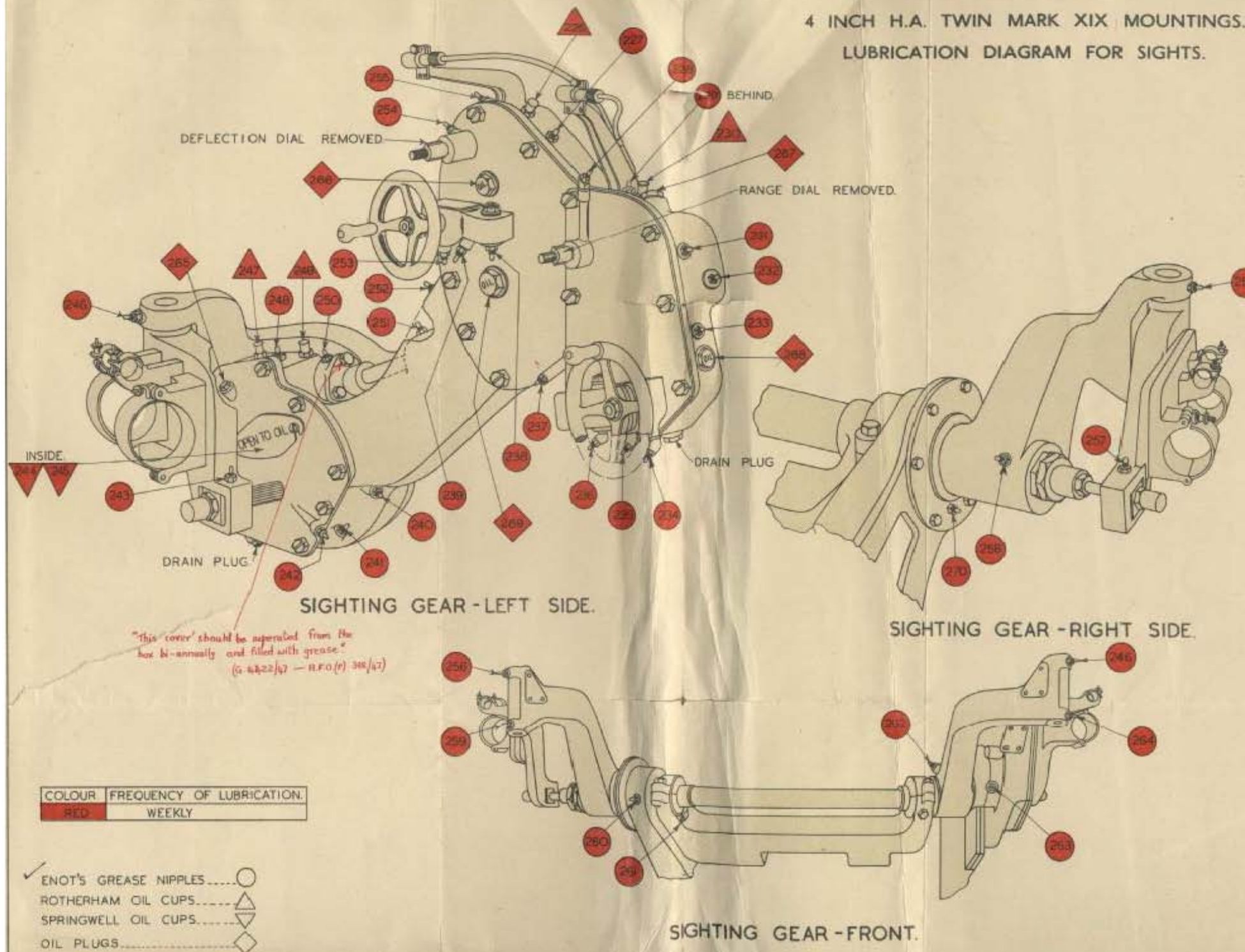
REFERENCE COLOR OF LUBRICATOR	FREQUENCY OF LUBRICATION
RED	WEEKLY
GREEN	MONTHLY
BLUE	MONTHLY

101-100. Bottom left. After "EXOTS GREASE GUN NIPPLES" add ---  
 "Defective" non standard nipples are to be replaced by the equivalent Admiralty Pattern (British standard) type nipples.



# 4 INCH H.A. TWIN MARK XIX MOUNTINGS.

## LUBRICATION DIAGRAM FOR SIGHTS.



COLOUR	FREQUENCY OF LUBRICATION.
RED	WEEKLY

- ✓ ENOT'S GREASE NIPPLES.....○
- ROTHERHAM OIL CUPS.....△
- SPRINGWELL OIL CUPS.....△
- OIL PLUGS.....◇